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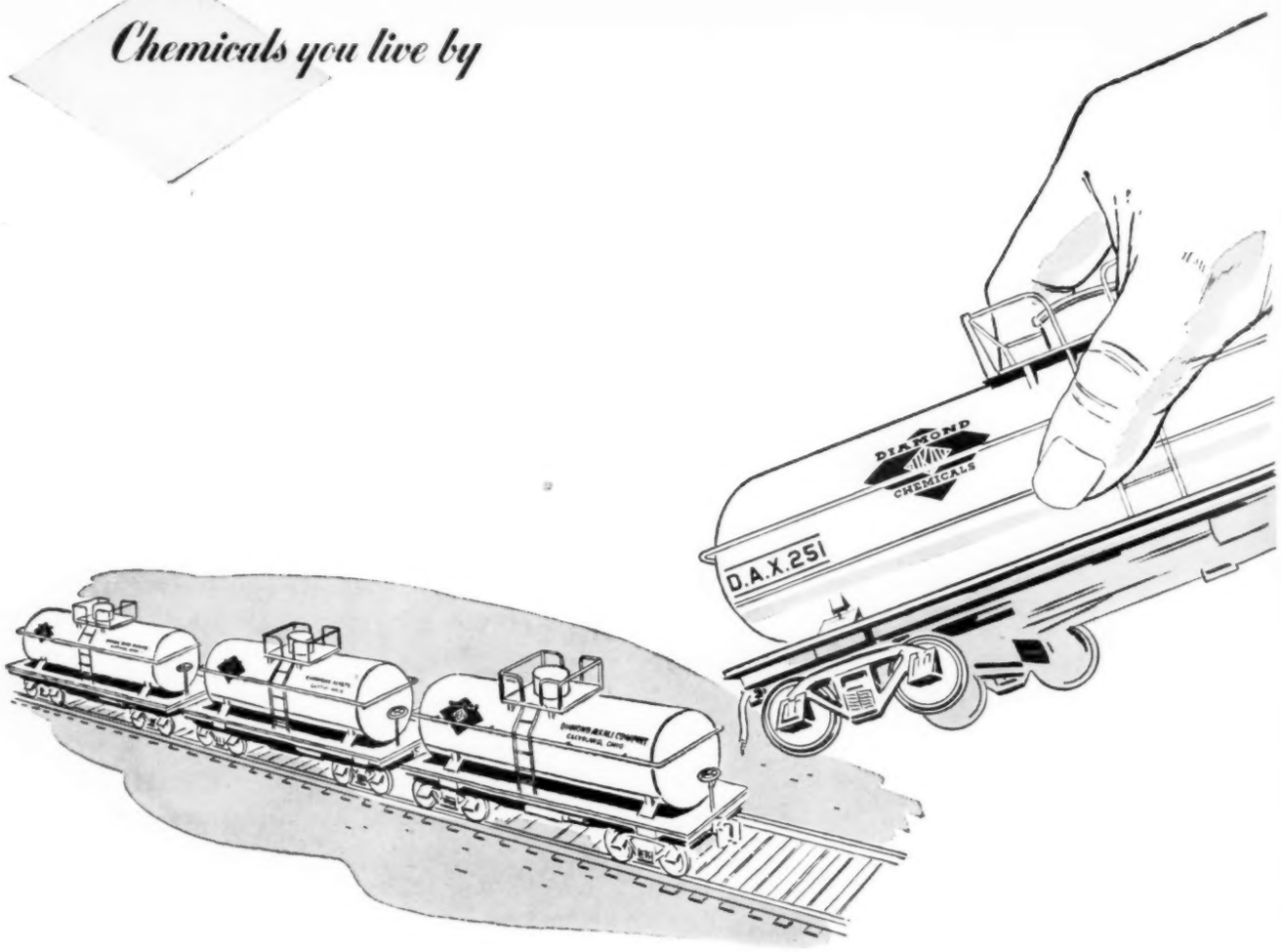

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ARMED FORCES CHEMICAL JOURNAL

OFFICIAL PUBLICATION OF THE ARMED FORCES CHEMICAL ASSOCIATION

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COVER PHOTO

F-80 Jet aircraft of the USAF. This type will participate in demonstrations at the Annual Meeting of the Armed Forces Chemical Association.

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NEWS OF THE SERVICES

★ Service PX Probe

The powerful chairman of the House Armed Services committee, Rep. Carl Vinson, who already has introduced a bill to make purchasers at Army and Air Force exchanges and Navy ship's stores pay the federal luxury taxes, is casting a cold eye at the extent of military store operations in general. "They serve too many people," says Chairman Vinson, declaring he favors abolishing the military stores at places where civilian stores are readily accessible.

★ Pentagon Major-Domo

In assuming the office of Secretary of Defense, Louis A. Johnson brings to the National Military Establishment a zeal for preparedness, a wealth of experience for attaining that state and a "toughness" to see the job through. As Assistant Secretary of War in the Roosevelt Administration, he was an exponent of industrial mobilization and in 1938 established the Chemical Advisory Committee to the Munitions Board which has maintained its life to date. His position as Secretary of Defense will serve as a reassuring element to those concerned with both the Nation's security and the future of the Chemical Corps.

LOUIS A. JOHNSON
Secretary of Defense

★ Training Pay Liberalized

A temporary change in the training categories of certain units of the ORC liberalizes training pay provisions for drill and training assemblies during the balance of the fiscal year. Units affected by the new order, effective until June 30, are those which do not have a full complement of personnel at the present time to enable them to take over their assigned combat functions. While they are building up to authorized Reserve strength, however, members of such units will no longer be denied opportunities to train with pay on a more frequent basis. ORC units with specific mobilization assignments which had been classified as categories III and IV have been moved up into category II, permitting participation in a maximum of 24 paid training assemblies each year. In addition, the new directive authorizes paid training assemblies for training units and groups up to a maximum of 12 each year. Formerly training units were entitled to only four paid drills per year and groups were not entitled to any pay.

★ Ike's Assignment

The duties of General of the Army Dwight D. Eisenhower in the military establishment, long a subject of speculation, have been defined by the Secretary of Defense. Accordingly, Ike's tasks include: (a) helping resolve differences of conviction between the services; (b) advising the Secretary of Defense on organization and procedures of his office; (c) advising the Secretary and the President on questions that are not resolved by unanimous decision of the Joint Chiefs; (d) monitor and expedite all work that properly pertains to the Joint Chiefs and to keep the Secretary of Defense informed of progress; (e) help in preparation of basic defense plans and in preparation of budgets based upon these plans.

★ Security vs Appropriations

According to the National Planning Association, an organization of nonprofit nature conducting studies of the problems of government, business, labor and the professions, the Army, Navy and Air Force is not giving the Nation enough security for the appropriations they receive. The association urges establishment of a civilian commission to keep tabs on military expenditures as long as they remain at their "present magnitude." A check would be made on waste and inefficiencies in all branches. Four factors, in the opinion of the NPA, seem to be cutting down the security yield: (1) rivalry between the three branches, particularly between the Navy and Air Force; (2) an easygoing attitude toward expenditures which is a result of the spending habits of war; (3) a surplus of high-ranking officers, also a result of war; (4) national defense appropriations historically have been on a "feast or famine" basis. The services "make large demands when the opportunity is presented, and spend as much as possible from appropriations before they lapse."

★ Reserve Affairs Bureau

Rep. L. G. Clemente, a member of the House Armed Services Committee, has introduced a bill (HR 2696) to establish a Bureau of Reserve Affairs in the Department of the Army and Air Force. The agencies would be charged with supervision and correlation under the chiefs of staff of all activities of the ORC and ROTC. The Chief of Bureau would be selected from reserve officers who have had 10 or more years of commissioned service in the corps and attained at least the grade of lieutenant colonel. Upon acceptance of the office the chief would be commissioned a lieutenant general in the AUS or AFUS, respectively. Personnel on duty in the present executive office for Reserve Affairs would be transferred to duty in the proposed bureaus.

ANNUAL MEETING

OF THE ARMED FORCES CHEMICAL ASSOCIATION

EXHIBITION AIR SHOW CONDUCTED BY UNITED STATES AIR FORCE COMBINED WITH CHEMICAL EXHIBITS AND DEMONSTRATIONS PROMISE ANNUAL MEETING VISITORS A PROGRAM OF UNUSUAL INTEREST. EDGEWOOD CHAPTER URGES EARLY RESERVATIONS.

The fourth Annual Meeting of the Armed Forces Chemical Association, complete from chemical demonstrations and exhibits to a full hour United States Air Force presentation of jet plane tactics and simulated bombing runs, will be held at the Army Chemical Center, Edgewood, Md., May 19, 20, and 21.

The three day program as announced by the Army Chemical Chapter is as follows:

Thursday, May 19—8 a.m. to 8 p.m.—Registration for Board of Directors and other members who arrive early; 9 a.m. to 5 p.m.—Interim activities; 5 p.m. to 6:30 p.m.—Informal cocktail party for Board of Directors; 6:30 p.m. to 7:45 p.m.—Dinner for Board of Directors; 8 p.m.—Board of Directors meeting; 8 p.m.—Reunion Social.

Friday, May 20—8 a.m. to 12 noon—Registration and interim activities; 10 a.m. to 12:30 p.m.—Annual Meeting of Armed Forces Chemical Association; 1 p.m. to 2 p.m.—Luncheon; 3 p.m. to 5 p.m.—Demonstration or special exhibits; 5:30 p.m. to 7 p.m.—Cocktail Party (Mixer); 7 p.m. to 9:30 p.m.—Annual Dinner; 10 p.m. to 1 a.m.—Dance and Night Club type party.

Saturday, May 21—8 a.m. to 10 a.m.—Departure of Guests.

Building 237 will be used for registration and fee collections and large signs to direct visitors will be located at the main gate of Army Chemical Center. In addition, large stickers reading "Armed Force Chemical Association Member" will be placed on the windshields of the cars of those members who arrive by automobile.

The cocktail party, annual dinner and dance will be held in the post recreation hall as was done last year.

The committee in charge of the program has indicated that the demonstration or exhibit will emphasize research and development as well as civilian defense. However, since many of the guests will not be cleared for secret information, security regulations will necessarily be enforced.

Arrangements will be made to stop certain indicated trains for the convenience of visitors and trains will be met by busses from the Army Chemical Center. Bus transportation will run to the interim activities and all guests will be transported to the demonstration by busses. Private cars will not be allowed south of the guard gates at the demonstration area.

During the forenoon of May 20, interim activities will be provided for guests of members who are not attending the annual meeting. Films of chemical warfare activities and visits to facilities will be scheduled. A committee will be available from each facility to act as guides for visitors.

One of the highlights of the Annual Meeting will be the demonstration by jet aircraft of the USAF. Arrangements for this event were coordinated through the efforts of Col. Harry H. Kuhn, National President of AFCA, who reports the Air Force has designated one of its top jet stunt groups to participate for members attending the Annual Meeting. Fighter tactics and simulated bombing runs will add a new page in Annual Meeting presentations and enable visitors to witness the latest in Air Force aircraft.

Members of the Association planning to be present at the Annual Meeting are requested to complete the registration form appearing on page 27 of this issue of the Journal and mail to National Headquarters in Washington, D. C. This will enable the Army Chemical Center Chapter to make the necessary reservations for those planning to attend.

The President's Message

By Col. Harry H. Kuhn, USA-Ret.

The policies of this Association are clearly stated in our constitution: "To sponsor new developments designed to increase the efficiency of chemical warfare, to collect and disseminate useful knowledge with respect to chemical warfare and related subjects, to foster a spirit of good will and cooperative endeavor among its members and with industry, and to perpetuate the friendship, memories and traditions growing out of their service in World War II."

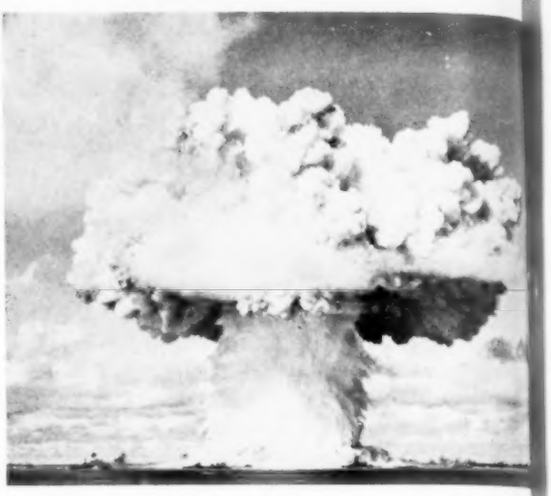
The stated objectives of the Association are in ascending order and the last one is the most important. This objective is reached in different ways. The Association roster is a ready reference not only for your friends but it holds together the collective knowledge which made the impressive record of achievement of the Chemical Corps in World War II. One of the principal values of the Annual Meeting of the Association is the opportunity to meet old friends. While the program this year is a bit more compact, no time has been taken from the social side.

The Board of Directors meeting on the evening of May 19 and the general meeting in the morning of the 20th will complete the business part of the program. The program on the 20th provides for exhibits and visits to installations designed to bring you up-to-date on the new developments within the limits of security regulations. The afternoon demonstration will emphasize the mission of the Chemical Corps in its relation to both the Air Force and the Navy. A jet air show will uncover the recent advances in speed of movement and attack.

The additional load on the Army Chemical Center of handling the Annual Meeting is considerable. Advance registration will ease this load considerably and is imperative in so far as the annual dinner is concerned, as this is catered from Baltimore. Decide now to attend the meeting and mail the registration form which appears on page 27 in this issue of the Journal.

MILITARY APPLICATIONS OF ATOMIC ENERGY AND THE PROBLEM OF SECRECY

SECRECY OF THE TYPE WE HAVE USED AROUND THE ATOMIC ENERGY PROJECT IS A SWORD WITH A BLADE ON EACH END. IT IS JUST AS APT TO INJURE MORTALLY THE WIELDER OF THE SWORD AS THOSE AGAINST WHOM IT WAS FORMED.



HELEN OF BAKINI IN ACTION
". . . a city-destroying blast or no blast at all."

By J. A. Campbell*

December 2, 1942 has been hailed as the dawn of the Atomic Age, for, on that date, man first achieved for himself a *controlled* emission of energy from atomic nuclei. The one half watt rate of energy generation accomplished then has been described as one of the most fateful achievements in man's brief history on earth. Grand predictions based on this and subsequent discoveries have led many to expect immediate gross changes in their way of life. Now, more than six years later, in the absence of apparent gross changes and in the presence of continuous argumentation and secrecy these first predictions have lost their Utopian aura.

In the real face of the secrecy wall it has been difficult to evaluate the real promise, if any, in this new ability to control nuclear reactions, and to make valid predictions and judgments as to possible future applications. New information has seeped out from time to time but little integration of the seepings has been attempted. The problem of the future of atomic energy has become so intertwined with international relations that much of the best scientific reporting has been concerned with this aspect. That this should be so is particularly praiseworthy. Such presentations should have their place in the ARMED FORCES CHEMICAL JOURNAL and should be more eagerly read by the subscribers than the usual technical articles. It is impossible, however, to accomplish a full discussion of the present technical status of atomic energy and the international status of its use and control in one short article. In fact, either of these topics would require a "five foot shelf of books" for anything like a complete elucidation of the currently available material. It is the intention of this article to condense some of the more important elementary scientific knowledge now available, and to use this knowledge in an attempt to evaluate the possible future contributions of atomic energy to warfare. It is with some reluctance that the author confines himself to this field, for the peacetime applications offer much more hope for the future than the military uses. It is, however, utterly foolish to discuss these peacetime applications with any hope of their realization as long as there is a high probability or even possibility of war. Atomic energy is so potent a weapon in many ways that military utilization will take precedence over any real peacetime developments while the "cold war" attitude remains.

The two unique attributes of atomic energy, or nuclear energy as it should be called, are (1) the small size of the unit necessary to produce a large energy output, and (2) the nature of part of the energy produced, i.e. radioactivity described in such exotic terms as gamma rays, beta rays, neutrons, fission particles, etc. The applications in which atomic energy is most profitable depend on one or both of these properties, but the two characteristics are not separable and each must be considered in every utilization.

Potential military uses of the general power available from atomic energy are either as an explosive bomb, or as a means of propulsion of warcraft or missiles. The radioactive effects may best be utilized in lethal dusts and sprays, in direct poisoning due to ingestion, and in the marking and tracing of certain materials. The potential applications in military medicine are equally outstanding.

To aid in the comprehension of these applications a brief survey of the methods of nuclear energy generation is included here.

Energy Sources

It is now commonly accepted that mass and energy are two terms applying to different aspects of the same phenomenon and that it is possible to convert energy into mass or mass into energy, and further, that it is easy to calculate how much mass must be converted in order to give a desired amount of energy. Table 1 gives a set of conversion factors for this calculation. Production of a million kilowatt hours, for instance, requires the conversion of about one ten thousandth of a pound of mass to energy. This can be attained by burning about 200,000 pounds of coal with about 2,000,000 pounds of air. In the course of this process 0.0001 pound of mass will disappear and be converted into the energy (one million kilowatt hours). Each of the atoms of carbon in the coal and oxygen in the air has converted the infinitesimal amount of less than one ten millionth of a per cent (0.0000001%) of its mass into energy. Any process which will convert a higher percentage of mass into energy allows a corresponding reduction in total fuel tonnage. According to our present picture of the nature of matter practically all mass (99.95% of it) is

*Mr. Campbell is associated with the Department of Chemistry, Severance Chemical Laboratory, Oberlin College, Oberlin, Ohio.

concentrated in very small nuclear regions at the center of each atom. Any large scale (greater than 0.05%) conversion of mass to energy must, therefore, involve a change in these nuclei. Such changes have been known for years and have been induced at will in most of the elements but much more energy has been required to initiate a process than is yielded by it so that the proceses are not self-propagating and continuous.

Difficulties in Inducing Nuclear Reactions

In order for any source of energy to be profitable the process of energy evolution must be self-sustaining, i,e. a chain reaction must occur. first absorb energy to "trigger" its own reaction just as a lump of coal must be heated before it will burn. The problem of supplying this "excitation energy" is complicated by the very small size of nuclei which makes it highly improbable that an exciting particle will strike a nucleus. Ordinary atoms are so small that one hundred million of them arranged in single file would stretch only an inch, but nuclei are so small that if an atom were to be enlarged until it was a mile in diameter the nucleus would still be only about half an inch in size. In any given piece of matter less than one billionth of one percent of the volume is occupied by atomic nuclei. A rapidly moving particle exists in nature in any great quantity. Collision of a neutron, particularly a slowly moving neutron with a U^{235} nucleus causes the nucleus to fission, or break in two. In the process of fission about 0.1% of the mass of the nucleus is converted into energy. This means that the fission of all the atoms in one pound of U^{235} produces as much energy as would burning one million pounds of coal. Furthermore, the fission process in uranium involves the release of neutrons which can then be used to cause more fission and thus perpetuate the chain reaction. In the case of U^{235} somewhat more than two neutrons are produced for each nuclear fission on the average. The use made of these neutrons determines

TARGET MAPS IN WORLD WAR II
Much of our present trouble in Europe is due . . .

THE FRUITS OF ALLIED BOMBARDMENT
. . . to the effectiveness of explosive bombing.

TABLE I

Conversion Factor, K, in Equation: Energy=K x Mass

Energy	Mass Unit	K
Erg	Gram	9×10^{20}
BTU	Pound	3.9×10^{12}
KCal	Pound	9.8×10^{12}
Kwhr	Pound	1.1×10^{10}
Ft Poundal	Pound	9.8×10^{17}

Some of the energy released must be reabsorbed to induce reaction to proceed in the neighboring material. Thus, a lump of coal is heated by the radiation from its neighbors until it too catches fire and then uses part of the resulting energy to keep hot and maintain the reaction.

The chain process in nuclear reactions runs into two great difficulties arising from the unique properties of nuclei. In order for a nucleus to give out energy in a chain process it must will spend so little time in a piece of matter as to make it highly improbable that it will collide with and excite a nucleus. The difficulty is compounded by the atomic structure which places a shell of negative electricity about each nucleus while the nucleus itself is positively charged. Any slow moving electrically negative projectile aimed at the nucleus may be repelled by this outer shell while any positive projectile may be deflected away by the nucleus itself.

Nuclear Fission

Three nuclei have now been announced as having the properties outlined above necessary to maintain a nuclear chain reaction. They are known as U^{235}, U^{233}, and Pu^{239}, which means isotopes of uranium and plutonium of atomic masses 235, 233, and 239 respectively. Of these only U^{235} whether the energy is released in one great burst as in the atomic bomb or at a steady rate as would be necessary in a propulsion engine. If both neutrons evolved in a single fission collide with more U^{235} nuclei it is clear that each collision will result in a doubling in the number of available neutrons, which in turn will increase the rate of collision and, hence the rate of power production so that the whole piece of uranium will undergo fission in a very short space of time and give an explosion. The rate of this propagation is so fast indeed that the whole process will be over in about one millionth of a second which accounts for the tremendous burst of concentrated energy from atomic bombs. An explosion may be prevented in two ways. One is to keep the size of the uranium mass so small that the average neutron escapes

from the piece before it strikes a fissionable nucleus; the second is to introduce into the mass other material, which will react with the neutrons before they have an opportunity to strike a fissionable nucleus.

We have now spent a considerable amount of space in an elementary discussion of the method of production of nuclear energy. This has been necessary in order to comprehend some of the recent developments in military application to which we will now turn.

The Atomic Bomb

Both uranium and plutonium atomic bombs have now been made and exploded. In these explosions all the secondary neutrons produced in fission are allowed to cause further fission so that a rapidly increasing rate of energy evolution is produced until the mass is scattered by the cumulative explosive force. From data in the Smyth report and elsewhere it can be deduced that the size of the explosive charge is about thirty pounds with about the same diameter as a softball. Any size smaller than this would allow neutrons to escape on the average before colliding with fissionable nuclei so that this is known as the critical size. No smaller atomic bomb can be made, and any larger piece will explode spontaneously. Thus there is no possibility of a weakly explosive atomic bomb. One either creates a city-destroying blast or no blast at all.

Released, as were the bombs over Japan, at a height of about one third of a mile (which is higher than the tip of the Empire State Building) the blast wave is of such magnitude that 100% destruction is accomplished over a circle a mile in radius below the center of the blast. Even if there were no other effects this would be by far the cheapest method of destroying a city. The cost of an atomic bomb is about one million dollars, the cost of delivery is very low since only one plane is necessary, and there is no need for precision bombing. Only 3.5% of the high explosive bombs dropped on German oil refineries during the war damaged the target, because of poor aiming, but the two main targets at Nagasaki almost two miles apart were completely destroyed by one atomic bomb dropped half way between them. In addition to the blast destruction, the tremendous heat generated by the bomb is sufficient to give surface temperatures in the thousands of degrees a half mile from the center, starting many fires in addition to those resulting from the blast damage to pipe lines and electrical systems. Some 5 to 10% of the people within 1000 yards of the blast survived both the blast and the heat, but most of these died from the lethal dose of neutron and gamma radiation they received even though thick concrete walls intervened between them and the blast.

It is safe to say that atomic bombs will not do much that cannot be done with other weapons, but the destruction can be wrought so much more quickly, so much more cheaply, and so much more unexpectedly as to raise this weapon into a class far more powerful than the past weapons of war. In spite of this increase in magnitude of possible destruction by a factor of a million the situation seems best summarized by Einstein when he says, "The atomic bomb has created no new problems; it has merely made it more mandatory that we solve some of the old problems."

Propulsion Machines

An engine running on atomic energy must deliver power at a constant rate rather than in bursts as does the bomb. It is essential, therefore, that only one neutron from each fission process go on to produce another fission on the average. Since better than two neutrons are produced per fission it is necessary to utilize somewhat over half of them in other ways. Various means of doing this have been announced. The most ingenious uses the extra neutrons to create more fissionable material. Thus, while U^{235} is the only fissionable material occurring in nature, it is possible to convert both U^{238} and Th^{232} (thorium of mass 232) into fissionable materials (Pu^{239} and U^{233}) by bombarding them with neutrons. Introduction of the proper amount of either U^{238} or Th^{232} into the engine uses up the excess neutrons and at the same time creates additional nuclear fuel. Such machines, known as breeder piles, can theoretically create nuclear fuel faster than they are using it, and allow at least a 200 fold increase in the amount of fissionable material over that which can be found in nature. On this basis there is available sufficient fissionable material to provide *all* the power requirements of the world for several hundred years.

"This Is Okay, But I Get A Bigger Bang Out Of City Life"

Such breeder piles require for their effective operation the presence of fairly large amounts of carbon or heavy water to slow down the neutrons to the point where they can be most effectively used to produce both fission and additional fissionable material. These carbon or heavy water moderators are bulky and the machines are large. Recently it has been announced, however, that a successful engine has been made which does not have these moderators in it but utilizes the fast neutrons directly and is, as a result, considerably smaller than previously existing models. Thus one has for the first time an inkling that these machines can actually be reduced to the size where they will be feasible for vehicular propulsion.

Such atomic energy engines are particularly attractive in warships, especially submarines. The units are completely self-contained, and may run indefinitely at a high energy output rate with the consumption of only very small weights of fuel. As these atomic energy engines operate they emit very large amounts of lethal radiation which can be absorbed only by thick protective shields. Such shields might consist of about four feet of steel or five feet of concrete and ordinarily would be considered a drawback to the engine. In the case of warships this need not be so for the shield can serve the double purpose of shield to protect the personnel from the radiation and armor plate to protect the engine.

Many suggestions have also been made that atomic energy will power the aerial carriers of the future. That there is quite sufficient energy available for this is unquestionable and a ram jet engine would seem ideal, but the problem of heat transfer from the hot solid, which is the atomic engine, to the entry gases appears almost insuperable for the time being. On the other hand, if a rocket is to be constructed in which the atomic energy is to be used to boil a liquid whose vapors are ejected to propel

the rocket, one runs into the present problem of the great mass of liquid which must be carried. The fast neutron engine mentioned above does show some promise here, and it is safe to say that a guided missile, powered by atomic energy, carrying an atomic bomb to any spot in the world is in the foreseeable future.

Radioactive Dusts and Sprays

There are those, however, who predict that no atomic bombs would be used against cities were another war to start. They say this not from any sense of wishing to save civilians from the horrors of war but only because other weapons may be considerably more effective. In fact a high official recently stated that atomic bombs now ranked fourth in our arsenal of weapons. It may be that he underrated their power but let us consider the alternatives. Biological warfare will almost certainly outrank atomic bombs in effectiveness. We shall leave one of the four weapons in the secret class and suggest that the other one is a radioactive dust or spray. The atomic bomb is tremendously effective. In fact, it is too effective. Much of our present trouble in Europe and Asia is due to the effectiveness of explosive bombing and the consequent destruction of property. It would be much better if the property could be rendered useless for a specified period of time at the end of which it could be rehabilitated. Such possibilities are latent in radioactive clouds.

The general application of a radioactive cloud was vividly demonstrated in the underwater explosion at Bikini. Only a few ships were sunk but those within about one mile of the explosion were all put out of commission. Not out of commission in the sense that they were destroyed. They were in fact quite seaworthy in many cases. Yet they were definitely out of commission and still are more than two years later. This is because the disintegration products of the bomb were trapped in the water and rained down upon the decks of the ships becoming firmly embedded in their metal surfaces. Scrubbing proved to be quite futile as an attempted method of removal, and the lethal rays from these materials effectively prohibit any crews from remaining on the ships for extended periods. With a controlled cloud it would be possible to render a given site untenable for a rather definite period which might range from a matter of days on up to many years. There would be little or no physical damage but the location would be quite useless for the chosen time. With time the radioactive materials disintegrate at a rate which cannot be varied by man so that the spot will again become habitable after a predictable interval. Whole cities treated in this way would remain undestroyed but also uninhabitable until the radioactive materials had disintegrated.

It seems clear that such a use of atomic energy weapons against cities is considerably more effective than destroying the city. It may be pointed out that this treatment is equally effective in denying a large area of countryside to any movement of personnel. This could not be done merely by exploding an atomic bomb above the area.

One of the great advantages of the radioactive dust method is that it can utilize the waste material from an atomic energy engine which has already utilized the energy of fission of the uranium or plutonium. Normally the fission products must be stored as useless substances which must be completely away from all personnel. As dusts and clouds they may find a use.

Ingested Poisons

Plutonium is one of the most poisonous body poisons known. Only minute traces need be taken into the body to constitute a lethal dose, and no discussion of possible military uses of atomic energy would be complete without referring to the possibility of treating municipal water supplies with such materials. Methods are known for removing it and removing it completely from water but such treatments would be quite impossible on the scale necessary to satisfy the demands of a large city.

Military Medicine

The uses of radioactive materials in medicine are legion already and far beyond the scope of this article. Only one example will be cited to show the value of these materials in the military field.

It is well known that the ingestion of certain radioactive materials in small doses into the human body appears to have no bad effects, and that the size of these doses may be made such that the material may be followed as it passes around the body by detecting the radiation emitted from various portions of the anatomy. The intensity of the radiation indicates how much of the material is in a particular place. It is apparent that transport will occur only to portions of the body which are being supplied in a regular manner.

In surgical cases where amputation seems required it is often desirable to find just how much of the tissue is still in satisfactory shape as far as normal function and circulation are concerned and to amputate as little as possible of the limb. An injection of radioactive salt allows a rapid determination of this limit. The salt will enter the circulating blood and will be carried to all parts of the body which are getting their normal supply and not beyond. A detector for the radiations emanating from the salt will then indicate the extent of healthy tissue and the point at which the amputation should be made. The technic is quite simple, is rapid, and is more sure than visual inspection.

The Problems of Secrecy

Much has been said concerning the necessity of keeping "the secrets of the atomic bomb." Secrets in general and military secrets in particular are of four kinds. Secrecy may involve: (1) concealing the fact of possession of some item, (2) concealing the method of utilization and the effectiveness of the item, (3) concealing the fact of the number of these items in possession though their existence is known, and (4) concealing the method of production. None of these four is worth concealing unless its revelation would give aid and succor to the potential enemy.

The greatest secret of all is that of possessing a new military weapon for the simple reason that it is impossible to design a defense against an unknown offense. The next greatest secret is the effectiveness of the weapon and its method of use for the same general reason. Neither of these is a secret with regards to atomic weapons. The existence of the bomb has been amply demonstrated, and its effectiveness is quite well known. Even though presently designed bombs are more effective than those used in 1945 and 1946 they are effective only by a relatively small factor. Since the original bombs were already extremely effective there is little possibility of causing a really revolutionary change in power. In fact, there seems to be small gain in even trying to increase the effective range of the explosive more than say a factor of three over that used in Japan. It would almost certainly be better to use more bombs of this size than to trust too much to fewer very big bombs whose probability of delivery on the target may be smaller.

Is then, our rate of production of atomic weapons a secret? Yes, the exact rate is, but the approximate rate is not. Estimates based on many sources all lead to the conclusion that the rate is about one a week on a

(Continued on page 38)

THE USAF'S PULSE—JET SUBSONIC MISSILE
. . . aviation research will take the major portion of military funds.

FEDERAL RESEARCH AND DEVELOPMENT

ACCORDING TO THE FORTY-ONE BILLION GOVERNMENT BUDGET ESTIMATE SUBMITTED TO CONGRESS BY THE PRESIDENT, THE APPROPRIATION ALLOTTED FOR SCIENTIFIC RESEARCH AND DEVELOPMENT WILL BE WELL OVER A BILLION DOLLARS.

By Alex Leggin*

The post war enthusiasm of the Government for the public subsidy of scientific research and development has not receded the slightest bit if the President's estimate for the 1950 budget is any criteria. As a matter of fact funds to support this endeavor during the next fiscal year will be even greater than the appropriations in the past.

According to the $41 billion government budget estimate submitted to Congress by the President the appropriations allotted for scientific research and development will be well over a billion dollars. These funds not only cover the operation of present government research installation and contracts to industrial and educational institutions but also the construction of new government facilities.

The increase in research funds for the coming year is a continuation of the trend that the administration has been following for the past twenty years. In 1930 the Government spent only $23 million for research and development. During the next ten years it was increased to $67 million. The war years, however, lent an impetus to this program due to the necessity of finding new weapons to assist the Armed Services in winning war. During these war years approximately $500 million was spent annually for research and development. The fruits of this investment in research and the role played by the scientists in hastening the defeat of the enemy was soon recognized by both Congress and the administration. Furthermore, it was also recognized that the United States must keep abreast and ahead of the other nations of the world scientifically. To implement this post-war program of research and development, in 1946 the Government increased the appropriations to $625 million dollars. Each succeeding year has also brought increased appropriations with the highest appropriation in history coming during the next fiscal year. The enthusiastic interest of the government in scientific research and development is indicated by the 50 fold increase in the appropriations during the past twenty years.

*Mr. Leggin is the Washington representative of Wyandotte Chemical Corporation and a vice-president of the Armed Forces Chemical Association.

National Military Establishment

As in the past decade the largest sponsors of Federal research and development will be the Armed Forces. The combined budget estimate of the three military groups under the National Military Estab-

lishment will total $553 million, approximately one half of the Federal Government's funds for this purpose. The Navy again leads with an estimate of nearly $228 million. The Air Force, in second place, is asking for $215 million, an increase of $70 million. The Army will require roughly about $108 million. In addition, the National Military Establishment is asking $1.7 million for its Research and Development Board.

A further breakdown of the military budget indicates that aviation research will take the major portion of the funds. In addition to the $215 million of the Air Force, the Navy will contribute nearly $80 million to this field and the National Advisory Committee on Aeronautics will add another $63 million, making a total of $358 million.

According to the Air Forces estimate $138 million of their request will be devoted to development of new aircraft and $21.5 million for research relating to aviation. The remainder is earmarked for operations, maintenance, etc.

The Army's breakdown is similar to last year's appropriation with the Ordnance Department leading with a requirement of $47 million. The estimates of the other Army Technical Services are as follows: Signal Corps, $30 million; Chemical Corps, $12.6 million; Quartermaster Corps, $8.3 million; Engineers, $5.7 million; Medical Department, $3.6 million; and Transportation Corps, $660,000.

In the Navy, the top group is the Bureau of Aeronautics with its $80 million. The remainder of the funds are listed as follows: Bureau of Ordnance, $62 million; Bureau of Ships, $39 million; Bureau of Yards and Docks, $2.5 million; Bureau of Medicine and Surgery, $2.5 million; and the Office of Naval Research, $42 million.

The Office of Naval Research, which sponsors basic research in all fields of science, will provide $18 million of its funds for research in universities and other outside institutions, and $15 million for projects within the Naval Research Laboratory.

Atomic Energy Commission

According to the budget estimate, the Atomic Energy Commission needs for the next fiscal year will be $740 million in cash appropriations and $427 million in contract authority. Approximately $200 million of this amount will be spent for research and development and construction of research facilities. Undoubtedly, the appropriations for research in the fields of atomic weapons, new sources of fissionable materials, and atomic power plants will also involve additional funds which are not revealed in the budget figures.

The National Advisory Committee for Aeronautics, the government agency responsible for scientific study of the problems of flight and for the conduct of research and experiments in aeronautics, is asking for $63.7 million for next year. This amount represents an increase of $15 million over the present appropriation. The research program of the Committee is now devoted almost entirely to the solution of problems of military aviation in support of the expanded air programs of the National Military Establishment. However, it is to be expected that some of the current work of the committee will also ultimately be reflected in improved aircraft for use in civil aviation.

Among the other old line agencies, the Department of Agriculture is the leader in the amount of money being spent for scientific research. For the coming year the Agriculture Department is asking for approximately $80 million. Nineteen million dollars of this amount has been earmarked to carry out the provisions of the Research and Marketing Act of 1946 (Public Law 733, 79th Congress). The remaining $61 million will be utilized by the Agricultural Research Administration which supervises the Office of Experiment Stations, Bureaus of Animal Industry, Dairy Industry, Plant Industry, Soils and Agricultural Engineering, Agricultural and Industrial Chemistry, and Human Nutrition and Home Economics.

Next in line is the United States Public Health Service which is responsible for such research facilities as the National Institute of Health, National Cancer Institute, National Institute of Mental Health, National Heart Institute, and National Institute of Dental Research. According to the best available figures, the Public Health Service will require approximately $50 million for research next year. This amount is an increase over last year, since funds are being provided for the first time for the Heart and Dental Institutes. The research appropriation mentioned above not only includes funds for the operation of the various institutes but also provides for other activities such as grants in aid to universities, outside institutions and to individuals for research and training purposes.

The Department of Interior with its two large research bureaus, the Geological Survey and Bureau of Mines, is scheduled for $42 million. The Geological Survey will require $18 million while the Bureau of Mines needs $24 million. The Synthetic Liquid Fuels program being conducted by the Bureau of Mines has the largest requirement—$10 million. This appropriation is required for research, laboratories, and demonstration plants and does not include funds for any commercialization of any large scale synthetic fuel plants that have received so much publicity lately.

The Department of Commerce has requested $9 million for the program of its Bureau of Standards. From this appropriation the Bureau plans to spend $4.4 million for Research and Testing and $3.2 million for Radio Propogation and Testing. There has been a very small increase over the funds received last year by the Bureau.

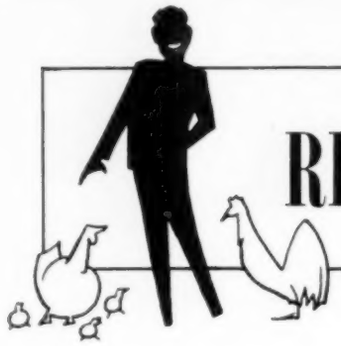
The Office of Technical Services, also of the Department of Commerce, which collects and disseminates technological information both foreign and domestic, has been earmarked for only $175,000 this year.

The above listed Departments are to the major sponsors of scientific research and development for the Government and spend about 95% of the funds for this purpose. There are, however, a number of other agencies which conduct research but on a smaller scale. These agencies include the Tennessee Valley Authority, Veterans Administration, Federal Works Agency, Smithsonian Institution Treasury Department and Federal Communications Commission.

National Science Foundation

For the past four years Congress and the President have been kicking around legislation for the establishment of a National Science Foundation, a proposed Federal agency to sponsor basic scientific research. With the President and Congress both under the same party at this time it appears that the Foundation will in all probability be established. The President has asked Congress to appropriate $15 million for this Foundation. In asking for this appropriation the President stated:

"The strength and economic welfare of our country in years to come are largely dependent on the advances that can be made in basic scientific research. To maintain and expand the Nation's efforts in scientific research and to help assure an adequate supply of trained scientists in the future, I again urge that the Congress enact legislation creating a National Science Foundation in a form which does not contain the basic administrative defects of the bill passed by the Eightieth Congress."



RETIREMENT FOR RESERVISTS

AT THE TIME OF PEARL HARBOR THE ARMY WAS HARD PRESSED AND SORELY IN NEED OF TRAINED RESERVE OFFICERS. TO OFFSET ANY REPETITION, CONGRESS HAS PROVIDED A RETIREMENT LAW AS AN INCENTIVE FOR RESERVISTS TO REMAIN ACTIVE AND PROFICIENT.

By Col. John P. Oliver, JAG-Res.*

In keeping with our traditional policy, in time of peace a small but highly trained Regular Army is maintained. In time of war or national emergency this peace-time army is multiplied many fold. Modern armies are not raised by "sowing the dragons teeth." Modern armies must be composed of officers and men trained in their military specialty. To have available such an army in time of war or emergency, and yet maintain a small regular force in time of peace requires that there shall be available for call when needed, a trained reserve. Every June from our schools and colleges are graduated members of the Reserve Officers Training Corps, commissioned in the Reserves for five years. These young men, trained at the expense of the government are an ever fresh increment into the Organized Reserve Corps. They represent a capital investment on the part of our nation, to insure the available officer personnel at a time when their services are required for an expanded war-time Army.

Many persons who have studied the needs of national security observed that during the period between World War I and World War II, many Reserve Officers lost interest in their military avocation, dropped out of the active Reserve and in time permitted their commissions to expire.

This action or inaction represented a capital loss to the government and what was of greater concern, the services of these trained officers no longer were available to the government. At the time of the attack on Pearl Harbor the Army was hard pressed and sorely in need of trained Reserve officers for the expansion of our forces at the time.

It was realized, following the time the shooting war was over, that it was necessary to provide an inducement for the members of the Reserve components to remain active, to continue their training, to hold themselves ready to serve. For this purpose it was considered advisable to establish a system of retirement pay.

Also, to accomplish parity with the Regulars for those of the Reserves who have remained on extended active duty over a period of years, it was necessary to permit such Reserves to accumulate retirement privileges during their periods of service, periods when similar retirement privileges were not available to them in civil life.

Path of Legislation

An attempt was made to have Congress pass such legislation in the 79th Congress. A bill was passed by the House of Representatives and just when it seemed that the Senate was about to accept the House bill an objection was raised and the bill was lost by the adjournment of Congress.

A new bill was introduced early in the 80th Congress, conference after conference was held between representatives of the Reserves and of the Regular services. A formula was agreed upon and hearings were held by the Armed Services Committee of the House. At last the bill was reported out of the Committee and passed by the House of Representatives. Over on the Senate side again objection was raised. Again meetings were held and a new formula was agreed upon. This formula in the form of an amended bill was finally passed by the Senate. Now in its new form the Reserve retirement bill again went to the House of Representatives. Here the amendments were agreed to and finally the bill HR 2744 was signed by President Truman on June 29, 1948, becoming Public Law 810—80th Congress.

At last there was an incentive for a Reservist to devote long periods of his leisure hours to reserve training. At last the Reservist on extended active duty was able to obtain retirement benefits as against his old age when he no longer would be qualified for military service.

Already the wisdom of the proponents of this legislation has been demonstrated. On the nights when troop schools are held for the Reserves throughout the country the percentage of those enrolled in attendance at the instruction has increased beyond the highest expectations.

The provisions of Public Law 810 apply equally to all members of the Organized Reserve Corps, be they commissioned officers or enlisted personnel.

Retirement with pay is available for officers and enlisted personnel of the reserve components of the Armed Services upon reaching the age of 60 years, who are qualified as set forth hereafter. Upon being granted retirement pay he is entitled also to have his name placed upon the Army of the United States Retired List.

Qualifying for Retirement

To qualify for this retired pay is not an easy accomplishment nor service that may be performed lightly or indifferently. In other words, to obtain retirement pay for Reserve service, the officer or enlisted person of the Reserves must **earn** his retirement as follows:

(1) He must have performed satisfactorily Federal service in the status of a commissioned officer, warrant officer, flight officer or enlisted

*Colonel Oliver, a Washington attorney, serves as Legislative Counsel to the Reserve Officers Association.

person in any component of the Armed Services.

(2) He must have completed an aggregate of 20 or more years of such *satisfactory* service in any or all services or components of which the last 8 years of qualifying service for retirement must have been as a member of a Reserve component. However, simultaneous service as a member of a Reserve component and a member of the Regular Army, Navy, Air Force or Marine Corps, shall not be deemed to be service in a Reserve component.

(3) If he was a member of a Reserve component on or before August 15, 1945, he must have performed active Federal service during any portion of either of the two periods, April 6, 1917, through November 11, 1918, and September 9, 1940, through December 31, 1946.

(4) He need not be a member of a Reserve Component to be entitled to retirement pay at the age of 60, if all other statutory conditions of service and qualifications have been met.

(5) The term "Federal service" includes all active Federal service and all service in an active Reserve component other than active Federal service or both. Service in the Army of the United States without component is deemed to be Federal service.

(6) Satisfactory Federal service or Federal service satisfactorily performed requires that the person concerned shall have conformed to such standards and qualifications as may have been required of him by law and appropriate regulations.

A "Year" Satisfactory Service

In order to qualify for a year of satisfactory Federal service under Special Regulations 140-60-1, Department of the Army dated December 28, 1948, the following must be met:

(1) Prior to June 29, 1948, each year of service as a member of an active Reserve component shall be deemed to be a year of satisfactory service for the purpose of the act and 50 points per year will be credited for such service, other than active Federal service. One point will be credited for each day of active Federal service including active duty for training.

(2) Subsequent to June 28, 1948, a year of satisfactory service shall consist of any year in which a person earns a minimum of 50 points including the 15 points earned for membership in an active Reserve component for each year of Federal service other than active Federal service. One point will be credited for each day of Federal service including active duty for training.

(3) In computing years of satisfactory Federal service prior to and subsequent to June 29, 1948, when there is a portion of a year the 50 points credited prior to June 29, 1948, for each year of satisfactory service and the 15 points credited subsequent to June 28, 1948, for membership in a Reserve component will be prorated. *Example:* Commissioned January 1, 1933. On June 28, 1948, completed 15 years, 5 months and 28 days satisfactory Federal service (15.49 years), including 5 years of active duty. 360 points are credited for each of the 5 years of active duty and 50 points for each of the 10 years of inactive duty plus 25 points for the 5 months and 28 days of the last year.

The term "year" is interpreted as follows:

(1) Prior to June 29, 1948, a "year" of service is considered to be any 365 days, not necessarily consecutive.

(2) On and after June 29, 1948, a "year" will be computed from June 29 to June 28 inclusive, for each following year for persons who are members of a Reserve component of the armed services on that date.

(3) For persons who enter or reenter the service after June 29, 1948, the year will be the annual inniversary of such entry or re-entry. Renewal of a commission, warrant, or re-enlistment will not constitute reentry if reappointment or reenlistment is effective on the day following termination or discharge.

Point Accumulation

To obtain "point credits" for a year of satisfactory Federal service, points will be credited as follows:

(1) One point for each day of active Federal service.

(2) Fifteen points will be granted for membership in an active Reserve component for each year of Federal service other than active Federal service.

(3) One point per calendar day will be credited for: authorized par-

THE AUTHOR (Left) WITH SENATOR CHAN GURNEY
"It was considered advisable to establish a system of pay."

RESERVE RETIREMENT BECOMES A LAW OF THE LAND
"At last there was an incentive . . ."

ticipation in field training; attendance at training assemblies; equivalent training, instruction, duty or appropriate duties; performance of administrative functions; for suitable duties performed by specialists, scientists, or individuals having D/A mobilization assignments. When any of these are attended or participated in for a minimum of two hours unless otherwise designated one point will be credited.

One point will be credited to the instructor at classes of troop or group schools, however to compensate for the necessary time spent in preparation not to exceed two points will be credited for the day or days preceeding the preparation.

Points will be credited at the rate of one point for each three rated hours of Army Extension Courses and on the anniversary date of each year points will be credited for work satisfactorily completed even though the series has not been completed at that time.

Other types of duties and services are likewise rewarded by these valuable points.

No limit will be imposed as to the number of inactive duty periods attended in any "year" but not more than 60 points per year, including the 15 points credited for membership in an active Reserve component, may be credited for inactive duty in a "year."

Only those persons who are members of an **active** Reserve component are qualified to earn points.

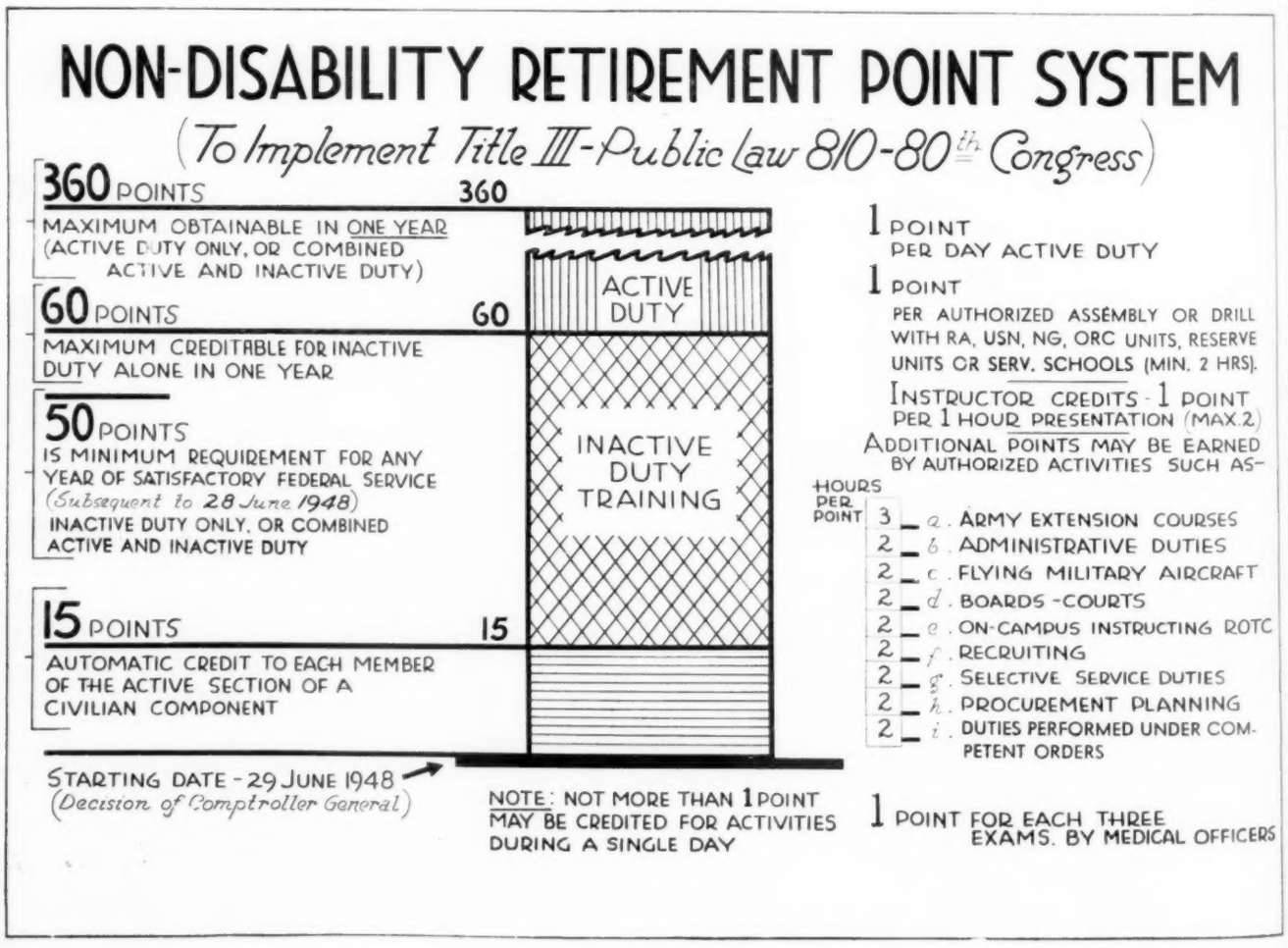
If a member of any Reserve component fails to conform to the standards and qualifications for retention in an active Reserve component, he will be transferred to an inactive Reserve status or retired *without pay* if qualified for such retirement or his appointment shall be terminated.

This action will terminate such person's retirement benefits under the Act, however reinstatement in an active section of a Reserve component will renew an individual's eligibility to accrue credits toward retirement and will constitute a re-entry.

Not more than 360 points, including all active and inactive duty points may be credited to any individual in any one year. After June 29, 1948, all points earned in any year, including the 15 points credited for membership in an active Reserve component will be credited to the individual and will be used in computing the retirement pay even though the minimum of 50 points were not earned for a year of satisfactory Federal service.

The above comments as to the manner of acquiring points for a "year" of satisfactory service have been summarized from Special Regulation 140-60-1, Department of the Army. Information not contained in the foregoing article may be obtained from this Regulation which is available at any ORC headquarters or at your National Headquarters in Washington. Similar regulations for the Navy and Air Force are not available at the time of this writing. However, it may be assumed that such regulations will vary but slightly from this Special Regulation of the Army.

One last comment—if you are now 60 or over, a member of the Army Reserve with 20 or more years service you may obtain the necessary forms to apply for retirement from The Ajutant General, Department of the Army, Washington, D. C. Air Force officers may secure the same by writing The Air Adjutant General, Department of the Air Force. Naval officers may write the Director of Personnel, Department of the Navy, Washington, D.C.


NON-DISABILITY RETIREMENT POINT SYSTEM
(To Implement Title III - Public Law 810 - 80th Congress)
360 POINTS
MAXIMUM OBTAINABLE IN ONE YEAR (ACTIVE DUTY ONLY, OR COMBINED ACTIVE AND INACTIVE DUTY)
360
60 POINTS
MAXIMUM CREDITABLE FOR INACTIVE DUTY ALONE IN ONE YEAR
60
50 POINTS
IS MINIMUM REQUIREMENT FOR ANY YEAR OF SATISFACTORY FEDERAL SERVICE (Subsequent to 28 June 1948)
INACTIVE DUTY ONLY, OR COMBINED ACTIVE AND INACTIVE DUTY
15 POINTS
AUTOMATIC CREDIT TO EACH MEMBER OF THE ACTIVE SECTION OF A CIVILIAN COMPONENT
15
ACTIVE DUTY
INACTIVE DUTY TRAINING
STARTING DATE - 29 JUNE 1948
(Decision of Comptroller General)
1 POINT PER DAY ACTIVE DUTY
1 POINT PER AUTHORIZED ASSEMBLY OR DRILL WITH RA, USN, NG, ORC UNITS, RESERVE UNITS OR SERV. SCHOOLS (MIN. 2 HRS).
INSTRUCTOR CREDITS - 1 POINT PER 1 HOUR PRESENTATION (MAX. 2)
ADDITIONAL POINTS MAY BE EARNED BY AUTHORIZED ACTIVITIES SUCH AS-
HOURS PER POINT
3 a. ARMY EXTENSION COURSES
2 b. ADMINISTRATIVE DUTIES
2 c. FLYING MILITARY AIRCRAFT
2 d. BOARDS - COURTS
2 e. ON-CAMPUS INSTRUCTING ROTC
2 f. RECRUITING
2 g. SELECTIVE SERVICE DUTIES
2 h. PROCUREMENT PLANNING
2 i. DUTIES PERFORMED UNDER COMPETENT ORDERS
NOTE: NOT MORE THAN 1 POINT MAY BE CREDITED FOR ACTIVITIES DURING A SINGLE DAY
1 POINT FOR EACH THREE EXAMS. BY MEDICAL OFFICERS

Holding steady....

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or in the pioneering of any new industry.

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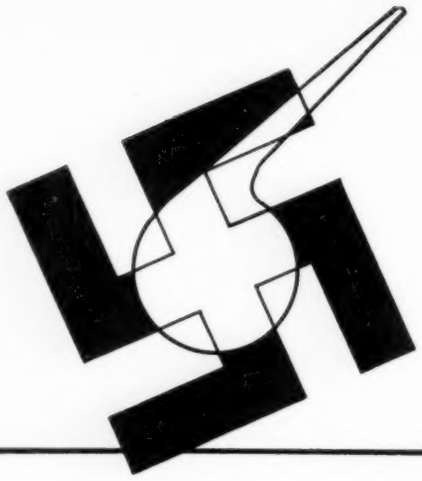

DISPOSAL OF CAPTURED CHEMICAL WARFARE MATERIAL IN THE U. S. ZONE OF GERMANY

By Col. Charles E. Loucks and 1st Lt. R. Bruce Elliott*

At the time of the cessation of hostilities in Europe nearly four years ago, large German stocks of toxic-filled munitions and toxic chemicals in bulk were scattered throughout Germany and in some neighboring countries in smaller amounts. Inspection of these plentiful reserves of all types of chemical warfare materiel confirmed the conclusions of wartime intelligence that Germany could have waged effective gas warfare. Among these stocks were aerial bombs, artillery shells, land mines, rockets, candles and bulk containers, not only of German manufacture but also some captured by the German Army, or manufactured for Germany in occupied France, Russia, Italy, Hungary, Czechoslovakia and other European countries. Fillings included mustard, nitrogen mustard, phosgene, diphosgene, chloracetaphenone, adamsite, chlorpicrin, chlorine, arsenicals and lewisite.

As these enemy stocks were captured by our forces, they were held for disposition instructions from Washington. In July 1945 the task of demilitarizing and otherwise disposing of all captured enemy chemical materiel was assigned the Theater Chief Chemical Officer, ETOUSA, now designated Chief, Chemical Corps, European Command. Five CML-CEM (Chemical-Captured Enemy Materiel) depots were organized in Germany at installations formerly used by the Wehrmacht and Luftwaffe for bulk storage, filling and shipment of toxic munitions. These depots were: Grafenwohr, Wildflecken, Frankenberg, Schierling and St. Georgen. The first two were phased out on 15 March 1947, the second two one month later and the last one on 6 September 1948.

A total of more than 100,000 long tons of materiel was consolidated at the five former ammunition depots and demilitarized during the program. The principal methods of disposition were: burning, demolition, decontamination, scuttling at sea, shipment to the United States and various European countries, and conversion to peacetime uses in Germany. The following table shows the official disposition figures:

Disposition	Long Tons
Shipped to US	12,200
Shipped to UK	7,908
Shipped to Italy	10,422
Shipped to Belgium	2
Sold to STEG	8,450
Scuttled at Sea	31,345
Destroyed in Place	32,530
TOTAL	102,857

Demilitarization plans called for the entire toxic disposal program to be eventually turned over to the Office of Military Government for Germany (US). This was effected in late 1946 when OMGUS assumed nominal control of the 58,120 long tons of materiel remaining at the five CEM depots. Stocks at four of these installations were then shipped to St. Georgen where the project was completed. The 193d Chemical Depot Company remained at that installation, at reduced strength, with intentions of providing only security and technical supervision to the operations conducted by Military Government. However, less than half the remaining tonnage had been disposed of by 1 July 1947, the original deadline date, and it soon became apparent that other arrangements were necessary. Consequently, on instructions from the Commanding General of the US Army in Europe, the Chief, Chemical Corps, EUCOM, again took over operational control of the program in late 1947, and carried it through to its final completion in August 1948.

Disposition of Chemicals

Over 12,000 tons of munitions and toxic chemicals were shipped to the United States for intelligence, experimental and historical purposes according to instructions from interested Government agencies such as the Army Chemical Center, Huntsville Arsenal, the National War Museum and Army Ground Forces Schools. Smaller outshipments were made to Belgium and Great Britain for similar purposes.

Sales to various Italian firms in early 1948 were arranged through the ULMER Corporation, with US State Department approval. The Italians' primary interest, however, was in the scrap metal value of the munitions rather than the recovery of raw materials from the toxic contents. Considerably less than one-third of the 36,000 long tons contracted for were shipped, due to reported labor difficulties which caused many train shipments to be held for weeks at a time without being moved or unloaded. Italian railway workers would not handle the toxic materiel without increased compensation. Therefore, this method of disposal was soon abandoned and it was decided to resume the scuttling program.

1,355 long tons of CN filled munitions were sold to Staatliche Erfassungs-Gesellschaft fuer Offentliches Gut (STEG), the German agency designated by the Bizonal Economic Council to receive such materiel.

*Colonel Loucks is Chief, Chemical Corps, European Command. Lieut. Elliott is assigned to the Office of the Chief, Chemical Corps, European Command.

STEG licensed several local firms to set up field plants at the St. Georgen depot, where the CN was reduced to its commercially usable basic components. STEG also disposed of 7,095 long tons of salvageable scrap, such as copper portions of shell casings.

32,530 long tons of munitions and bulk toxics were destroyed in place at the various CEM depots. This method, although more difficult and time consuming, was considered necessary in the disposal of leaking containers. The principal means of destruction in place was by burning the agents in open pits, particularly in the case of mustard and arsenicals, and the salvaging of metal components of ammunition. Empty metal bulk containers were decontaminated and disposed of as scrap where possible. Very large steel and concrete storage tanks were decontaminated and blown up. A German decontaminating agent, losantin, found in quantity with the captured materiel, was used in this decontamination with satisfactory results.

A total of 31,345 long tons of chemical munitions and bulk toxics was scuttled in the North Sea or the Skagerrack during the summer months of 1946, 1947 and 1948, using eleven hulks of American and German origin. Outloading operations were conducted at the Midgard Docks, in Nordenham, a suburb of Bremerhaven. The hulks were sunk in water at an average depth of more than 700 meters. The Commander of the US Naval Forces in Germany arranged to obtain the approval of interested neighboring countries, as required, towed all hulks to sea, and scuttled them either by opening the seacocks or by shell fire.

Detailed fire and disaster plans were set up and practiced during the outloading program at Nordenham, and all standard safety measures were observed. 5,000 pounds of chloride of lime, 1,500 pairs of impregnated gloves and 240 pounds of Army issue soap were expended in the 1948 operations at the Midgard Docks. Nevertheless, it proved difficult to instill German laborers with the proper respect for the toxic chemicals they handled. Fortunately, no major casualties were directly attributable to unsafe handling of toxics. A few workers received minor burns at various times, which were usually obtained from stolen items of contaminated clothing.

On the first day of loading aboard the hulk "PHILIP HEINIKEN" in July 1948, a box pallet of shells was being lowered into the hold when it struck the side of the hatch and spilled its contents into the hold. Two German laborers were struck by the shells, one being killed instantly and the other suffering a broken shoulder. This accident was determined to be the fault of the hatch signalman, a German, who gave an incorrect signal to the crane operator.

Two other serious mishaps connected with the program occurred at St Georgen and caused the death of eleven German workers. The first happened in September, 1947, when ten civilians died and ten were hospitalized as a result of the accidental explosion of a chemical land mine filled with H/PD (a lung irritant and blister gas mixture). As far as could be determined, this accident occurred during removal of the explosive element by a German female worker, preparatory to destruction of the chemical contents. Deaths and injuries were due to effects of the highly toxic gas concentration generated in the enclosed room housing the workers, as well as from concussion and from flying fragments of the metal components

The second incident occurred six weeks later when three German women were seriously burned, one of whom died later, by a powder flash. The victims were engaged in defuzing 7.5 cm shell casings, during which operation powder from the cartridges became ignited in an undertermined manner, resulting in the burning of nearby workers.

Shortages of personnel and equipment, especially in the latter stages of the project, served to delay the toxic disposal program considerably beyond its original expected date of completion. However, the deadline of 31 August 1948 was met and a certificate of clearance obtained from the Bipartite Control Office, OMGUS. It can thus be stated that no known stocks of captured chemical warfare munitions exist in Germany today.

DESTINATION: EDGEWOOD

A close-up view of the filling of a 250 KC aerial bomb with liquid mustard at the St. Georgen CML-CEM Depot. These German workmen, wearing German impermeable clothing and gas masks, are filling bombs which were shipped to the Army Chemical Center in May 1946. The transparent containers at top center indicated an overflow when bombs were filled above the required height, with allowance for expansion. This equipment was of the finest modern design and quality.

NAZI CHEMICAL "FILLING STATION"

This building, called the "hot filling house," was used for the filling of mines and shells with liquid toxics which were piped underground from million-liter storage tanks. This and all other structures at the St. Georgen Depot were exceptionally well camouflaged, consisting mainly of brown and green plastic material interwoven in wire nettinge, most of which has since been removed by occupying units. Concrete blocks served as blast protection against bombing attacks.

A RESERVE LOOKS AT THE ASSOCIATION

". . . WHILE THE ASSOCIATION HAS SET HIGH AIMS AND HAS MADE GREAT STRIDES IN ATTEMPTING TO ATTAIN THEM, IT IS BELIEVED IT CAN BE OF ADDITIONAL SERVICE TO THE CHEMICAL CORPS RESERVE OFFICER."

By Capt. Douglas G. Nicholson, CmlC-Res.

World War II created conditions which cast men of varied background, training, interest, and experience together to work as a team with one single aim. When hostilities had ceased, those of us who played on this great team found ourselves returning to previously held civilian jobs or to newly selected jobs in our former fields of interest. Many returned to school to complete unfinished education, while others chose to remain in uniform.

It is quite natural for men who spend several years working together to cherish the friends, associations, and experiences made while in uniform. Upon being separated they welcome membership in an organization which would serve as a general medium by which they could learn of current activities, trends, and developments in their particular arm of service. One may consider the feeling of these men as being similar to that experienced when a graduate of "Old Podunk" College sees his college name on the sports page of a newspaper. A warm feeling and an internal chuckle come over him.

In the majority of cases of Chemical Corps Reserves, the names "Edgewood," "Edgewood Arsenal," or "Army Chemical Center" are associated with memories (often not too thrilling). In any event, we are all rather familiar with Gunpowder Neck, its installations and surroundings. Information concerning activities in this area is read with more than casual interest. On the other hand, many of us are unable to attend the annual Homecoming celebration which is sponsored by the Armed Forces Chemical Association. Our only contract with our "campus" is through the media of the Armed Forces Chemical Association *News* and *Journal*.

When one considers the multiplicity of backgrounds, experience, and current interests of Chemical Corps Reserve Officers, and realizes that the major unifying agency is the Association (through its publications), he begins to appreciate its task. While the Association has set high aims, and has made great strides in attempting to attain them, it is believed it can be of additional service to the Chemical Corps Reserve Officer. The paragraphs below will outline a few suggestions relative to this topic.

Past issues of the Association publications have contained descriptive accounts of specific action in which certain chemical units participated. Others have contained articles concerned with the military role of service units, the history of developments of certain chemical weapons (4.2-inch mortar), while others have outlined the plans and programs of the Chemical Corps School.

The January, 1949, issue of the *Journal* contained two excellent articles of interest to the Reserve who has technical interests. On the other hand, the non-technical reserve would not be particularly interested in the details of the construction of the German mercury cathode chlorine cell or in the storage facilities of German gas dumps.

In an effort to grasp and maintain the interest of technical as well as non-technical Reserves who are now members of the Association, as well as provide a program of articles which would entice new members into its fold, it is believed that each issue of the publication should embrace a well distributed selection of articles. The personal column is welcomed and carefully covered in an effort to learn the current location of friends and ex-buddies.

Many of the Chemical Corps Reserve Officers are becoming associated with (a) newly activated chemical reserve units, or (b) Research and Development Training Groups. A listing of the roster and activities of certain of such units in each issue of the *Journal* would be of interest to all Reserves.

Many reserves are interested in the Research and Development Training Groups, but few are familiar with the fact that the actual organization of such groups must originate and be initiated by the Reserves themselves. The screening processes by which applications for membership in such groups are selected is quite rigid, and only qualified personnel are accepted.

A condensation or abstract of the statistics and figures presented by Dr. David M. Delo in his report, "Scientists in Uniform, World War II," would be of interest to many Chemical Corps Reserves. This report contains many statements and figures relative to the utilization of scientists in World War II which are food for thought.

The Reserve Officer's retirement plan (point system), which has recently been initiated, is being received with great interest by all concerned. It is very evident that the Association can and should do much to show the merits of this plan.

Most organized Reserve units meet once or twice each calendar month. If an officer attends 18 to 24 of these in a year, he still does not qualify for retirement with the essential 50 points. It is rather obvious that the Reserve who is interested in this program must serve a period of active duty of two to four (or more) weeks in order to obtain retirement credit for the specific year. An active tour as a student at the Army Chemical Center School is *not* particularly attractive to the Reserve who is engaged in chemical research in civil life. (This is especially true if he has had first-hand training or combat experience with certain weapons which must be assembled, named, and disassembled during the course of such schools.) Many Reserves with technical backgrounds (who are currently members of a Research and Development Training Group) are most interested in obtaining two to four (or more) weeks active duty at a Technical Command, Research Center, or Technical Testing or Prov-

(Continued on page 34)

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PROBLEMS OF THE CHIEF CHEMICAL OFFICER, SOUTHWEST PACIFIC AREA

THE MOST IMPORTANT TECHNICAL ACTIVITIES OF THE CHIEF CHEMICAL OFFICER PERTAINED TO THE EFFECTIVENESS OF TOXIC AND SMOKE MUNITIONS WHEN USED TACTICALLY UNDER THE TROPICAL CONDITIONS EXISTING IN THE THEATER.

COL. W. A. COPTHORNE
"One officer had some experience"

By Col. W. A. Copthorne*

The Chemical Service of the Southwest Pacific Area was initiated by the writer, 2 February 1942 at Melbourne, Australia, in the Headquarters U. S. Army Forces in Australia. This service was developed and expanded throughout the war against Japan, always with a shortage of personnel and without the aid of a single trained chemical officer of the Regular Army, as assistant or deputy to the Chief Chemical Officer.

Officers furnished for the establishment of the service initially were chiefly research chemists or chemists, and had limited service in the Reserve Corps or the Army. From these, it was necessary to develop supply personnel to handle five base sections initially, as well as the chemical supply section of the headquarters, one of them to be chief of the supply section. No officer had even the minimum of background of training in technical intelligence. One officer had some experience in training, through service as an instructor at the Chemical Warfare School at Edgewood Arsenal for a period of time. With one exception, none of these reserve officers had sufficient reserve training with the Regular Army to become familiar with Army administration. Capt. (later Lt. Col.) John C. Morgan was initially the Executive Officer, having arrived in Australia with the 42nd Cml. Lab. Co.

The accomplishments of this group of 18 reserve officers, as meagerly augmented from time to time, under the leadership and guidance of the Chief Chemical Officer, are outlined as follows:

Intelligence

The intelligence section headed up by Capt. (later Lt. Col.) John A. Riddick, through contacts with the Chief, Chemical Warfare Service, and through channels initiated direct with other theaters in contact with the Japanese, drew up the basis for a complete knowledge of Japan's chemical equipment, doctrine, and even the status of their most advanced technical experiments in chemical warfare. The Chief Chemical Officer, on first contact with Japanese combat forces in New Guinea, realized that little technical intelligence could be expected from the regular prescribed channel of unit gas officers and chemical officers of units in contact with the enemy. It was a "sideline." He, therefore, directed the organization and training of officers and non-commissioned officers to constitute technical intelligence teams to be sent forward with task forces on all combat missions, with technical as their sole mission. This proved so successful that, by the end of the war, all required information of Japan's chemical warfare equipment and munitions was available. This information was not only "on file" but each item was analyzed, sectionalized, and drawings and brief descriptions were printed in a looseleaf book which was furnished to pertinent personnel in all combat units, and to other theaters in contact with the Japanese.

Supply

Normal supply was developed by Captains Arthur H. Williams, Jr., and Irving J. Mollen so that it functioned adequately to take care of all requirements, and compared favorably with the best supply services in the theater. Special problems in the supply of spare parts, particularly for the 4.2 chemical mortar and the flame thrower, were solved in spite of shortages in the United States and late requisitions, by use of air transportation and special handling, with the result that 98% of the combat requirements for these items were furnished on time.

The supply of toxic chemicals and toxic munitions was maintained as far forward as policy would permit, in sufficient quantities to maintain active chemical warfare until resupply was received from the United States should active use of chemicals have been brought about. This is true only until the advent of the B-29 bomber, with its capabilities for carrying a greatly increased load of bombs.

The Chief Chemical Officer realized, as soon as the type of combat was disclosed in which our troops would participate, that the standard service gas mask was not only too heavy, but its usefulness was limited by the fact that it was not and could not readily be waterproofed. He consequently assembled all available lightweight training masks and secured further supply from the United States. Under his direction, a practicable method of waterproofing this mask was devised locally, and the entire number was put through a production line in the 10th Maintenance Company, preparing them for issue. These waterproof light-weight masks were issued to all assault forces in landing operations as long as the supply of 139,000 held out.

The first use of flame throwers in New Guinea disclosed that the weapon, as designed, could not be expected to stand up under the conditions of rain and mud and the abuse

*Colonel Copthorne is commanding officer of Pine Bluff Arsenal, Pine Bluff, Arkansas.

to which it could be expected to be subjected. Following suggestions of his subordinates, the Chief Chemical Officer had all flame throwers waterproofed locally, by methods locally devised, and provided a protective cover to minimize the hard usage to which they might be subjected. Since all combat troops appeared to be unfamiliar with the methods required to maintain flame throwers and maintenance procedures, each combat division was invited to send at least 20 selected men for instruction and practice in the maintenance and waterproofing of flame throwers. This was carried out by the 10th Maintenance Company of the Chemical Warfare Service.

Plans and Training

The Chemical Warfare Plan of the Southwest Pacific Area was drawn by the Chief Chemical Officer, personally, since he had no assistant who was trained in this phase of military activity. The plan was forwarded to the War Department and approved. G-3, GHQ, SWPA, on his return from a visit to Washington, stated that the plan was considered so favorably in the War Department that it was proposed to use it as a model for all theaters.

Early in 1942 there were two outstanding weaknesses in Chemical Warfare Service training of our forces. The training had been primarily academic, with no contact with toxic chemicals themselves, and it was found that texts varied as between themselves in the instructions for decontamination and first aid. Consequently, steps were taken immediately to correct these weaknesses. A pamphlet was prepared outlining the methods to be used in decontamination and first aid, and it was prescribed for use until superseded by official texts from the United States. This was printed and issued to all forces.

To provide practical training in decontamination, first aid, and defense against gas, mobile training teams were organized, trained and equipped with supplies of toxic agents. These teams visited all units of the ground and air forces, and gave practical training to the unit gas officers and gas non-commissioned officers of those organizations. They were particularly successful in making real, the proper gas defense procedures.

In June 1942 a Chemical Warfare school was established at Brisbane, under broad policies prescribed by the Chief Chemical Officer. This school gave more detailed instruction to unit gas officers than was practicable with the mobile training teams, and gave them such effective training in their duties that numerous commanding officers later wrote commendatory letters to the Commandant of the school. The Commandant of this school, Major Carl V. Burke, was awarded one of the first Legion of Merit decorations awarded in the SWPA, for his work with this school. The school was later moved to New Guinea and then to Manila.

As the war progressed, reports indicated that infantry units were lacking in uniform training in the use of flame thrower assault teams in the reduction of Japanese pill boxes, with highly variable results. With the cooperation of the Sixth Army Chemical Officer, a standard assault team was prescribed providing for the necessary protective fires, demolition men and men provided with smoke munitions, as well as flame thrower operators and assistants. Model teams of Chemical Warfare Service personnel were trained meticulously in the tactics and procedures to be used in the reduction of pill boxes, and their services of fered to the commanders of the various combat divisions for demonstration purposes. These teams were so effective that the first such team received commendatory letters from six different division commanders.

Technical

Technical activities in the SWPA were carried out by the Chief Chemical Officer, with the assistance of Major Walter W. F. Enz (later Lt. Col.) who had been commissioned three weeks before his departure overseas. He was a research chemist of Upjohns pharmaceutical firm, with little knowledge of the Army or Chemical Warfare problems. However, he learned quickly and mobilized the talents of chemists in the 42nd Chemical Laboratory Company, and the chemical and mechanical engineering talent that was available in other duties and normal technical problems were promptly solved. These initially involved modifications in Chemical Warfare equipment and supplies that were received with technical defects, and which were corrected in Australia with the cooperation of Australian industries. Through these industries, a source of supply for FS smoke mixture and bleaching powder, as well as critically needed spare parts, were secured. Through these activities, both time and shipping space were saved.

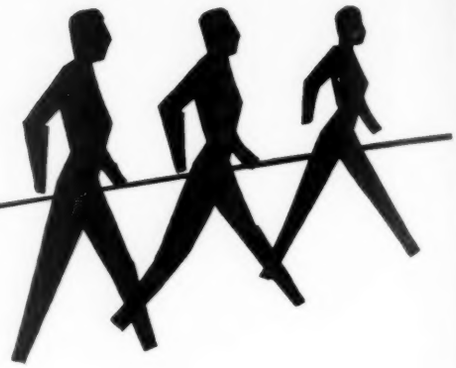
Certain chemical bombs used in demonstrations gave indications that the fuzes and bursters were not adapted to jungle warfare. On strong representations of the Chief Chemical Officer, two specially qualified technical men were sent from the United States with various types of fuzes and bursters for test. Bombs were tested in a jungle area, and it was disclosed that the standard fuze was too sensitive, and the burst spread the contents of the bomb over the jungle canopy with no appreciable penetration below. These tests resulted in a modification of the fuze which could be made in the field, and thus assured that the bombs, if used in a jungle area, would give the results expected of them.

The most important technical ac-

(Continued on page 40)

A FLAME THROWER "ASSIST" ON BOUGAINVILLE
Earlier training had been primarily academic . . .

SCIENTISTS IN UNIFORM *



AS FAR AS IS KNOWN, ATTENTION IS NOT BEING GIVEN TO SPECIFIC PROCEDURES AND MECHANISMS FOR EFFECTIVE MOBILIZATION, ALLOCATION AND UTILIZATION OF THE NATION'S SCIENTIFIC MANPOWER SHOULD WAR COME AGAIN.

Experience has demonstrated that scientists are a resource of major national importance. They represent specialized skills and knowledge which are of great value to the Nation's welfare in both war and peace. For this reason, special attention is necessary to insure that their skills are used to the maximum.

This is particularly true today. The tense international situation has many of the features characteristic of a decade ago. We are charting a course at home and abroad which may permanently affect our future as a free Nation. Whether the outcome be peace, war, or a long armed truce, science and scientists will play a vital role.

The mobilization and the utilization of scientists during any future national emergency resolve naturally into two components: (a) policies and procedures to control and allocate scientific manpower on a national scale, so that all agencies necessary to the war effort receive their fair share of technical personnel; (b) policies and procedures within the National Military Establishment to insure maximum usefulness of the scientists who enter the Armed Services.

Both problems should be of continuous concern to the Nation. It is not enough to wait until hostilities are imminent. Science now plays such a significant role in the economic, social, political, and military strength of the Nation that the means by which it progresses should be subject to constant study. The application of science to the military art, and hence to the defense of the Nation, also should be subjected to continuous and intense scrutiny.

If science is to be applied effectively to military activities during hostilities, it must be so utilized during peace. The mission of the Military Establishment during the years of peace is to prepare for effective national defense. Today the tempo of preparation is being accelerated and it is imperative that the contributions of science keep pace.

Numerous plans calculated to enhance the Nations civilian strength in science and scientific manpower recently have been proposed and some are being implemented. As far as is known, attention is not being given to specific procedures and mechanisms for effective mobilization, allocation, and utilization of the Nation's scientific manpower should war come again. *The nature of present planning based on a draft law similar to that of World War II suggests that if war were declared at once, we would utilize much the same methods for this purpose as were used previously.*

The nature of modern weapon development and the exigencies of any total war which may result from current or future international tensions make maximum utilization of *all* phases of technology a necessity for national security. The nature of modern warfare demands that our Armed Forces contain considerable numbers of highly trained scientists, able to function effectively and supported by many more in research laboratories and industry. The *minimum* education of one of these men requires 4 years; by the time a scientist becomes really effective he has expanded at least three times this period in education and experience. Experience indicates that there has never been enough scientific manpower to perform effectively all the tasks of national defense during national emergencies.

Scientists have expressed widespread dissatisfaction with the methods used nationally for the allocation of scientific manpower during the last war. Following the sound democratic principle that there should be no favored classes, all citizens became subject to military service. Unfortunately, the Selective Service regulations did not anticipate the role of the scientists—one-half of 1 percent of our population—upon whose shoulders rested a large share of the responsibility for victory or defeat. The situation has resulted in extreme statements by many individuals concerning the malassignment and misuse of scientists in uniform, and the damage done to essential war propects by the unwise drafting of scientists, both trained and in training.

As in the case of any other important national resource, it is necessary that we take immediate steps to plan for the military use of science and scientists.

The Scientific Component

The number of scientists in the United States has never been accurately determined. The President's Scientific Research Board Report recently gave a national estimate of 137,000 research scientists. During World War II, the National Roster of Scientific and Specialized Personnel listed approximately 400,000 individuals, not all of whom were scientists. The Engineers Joint Council estimates that there will be about 337,000 engineers alone in 1950. Although compilations might be based on the memberships of the individual

*Based upon and extracted from "Scientists in Uniform — World War II," a report to the Deputy Director for Research and Development, Logistics Division, General Staff, U. S. Army, prepared by Dr. David M. Delo Chief of the Scientific Manpower Section, Research and Development Group.

scientific and engineering societies, they would be inaccurate because many scientists belong to two or more of these societies. In addition, the societies do not include all professional workers in the fields which they represent. For example, the American Chemical Society estimates that its membership includes only approximately 70 percent of all working chemists in the United States. *The absence of an accurate cataloging of scientists is a serious deterrent to realistic planning.*

Although accurate quantitative information is not available, it is evident that the total number of scientists is very small when compared to the total number of men in the working population, that is, ages 18 to 60. A rough estimate would indicate that the scientists comprise less than 2 percent of the male working population.

In terms of men of military age available for service in the Armed Forces, the percentage is no larger. Based on results of this survey, it seems probable that the total number of scientists in uniform during World War II was less than 50,000. When compared with the total of approximately 8,000,000 men in uniform at any one time during World War II, it is apparent that the percentage of the Armed Forces discussed in this report is a very small one. Its importance, however, is highly disporportionate to its size. *Special handling of these individuals to insure that they make a maximum contribution to the entire military effort therefore represents no considerable withdrawal from the stream of men needed for nontechnical combat duty.*

Utilization Survey

In the absence of action by any other agency of Government, the Research and Development Division, WDGS, called a conference in October, 1946 to discuss the problem of scientific manpower mobilization. As a result of this meeting, a small informal committee and a number of advisory panels were established to consider the problem. The committee was at no time attached officially to any agency, but continued to function unofficially until March, 1948.

In general, the committee hoped to make recommendations which would lead to more realistic national policies and procedures for the mobilization, allocation, and use of scientific manpower in the event of another international emergency. The first logical step appeared to be the evaluation of scientific manpower utilization during World War II, and an analysis of the factors which governed this utilization. It was also planned to study the manpower controls used by other nations; to analyze our own manpower regulations; and to recommend new regulations and procedures to overcome the shortcomings revealed by this analysis. The establishment of the National Security Resources Board has now created an instrument of Government charged with these responsibilities for manpower as a whole.

In order to secure data concerning utilization of scientists in uniform, the Scientific Manpower Branch, Research and Development Division, approached a number of scientific societies to ascertain their interest in a survey to obtain information on this subject. Eventually societies representing nine major fields of science and engineering participated in the survey. Questionnaires were printed and circulated by the societies at their own expense.

Following machine analysis of the response, each participating society was furnished with detailed statistical tabulations. Each society subsequently prepared a report and a series of recommendations based on these data. The individual reports have been submitted to the Research and Development Group as official statements of policy from the respective societies.

This present report summarizes and interprets the results of the survey * * * although prepared primarily from the viewpoint of the Department of the Army, the analysis is based upon the responses of scientists who served in all of the armed services. No attempt has been made to separate these by service. Since it is difficult in a study of this type to separate completely the national aspects of the scientific manpower problem from those peculiar to the National Military Establishment, both are discussed.

It is realized that there was an insufficient number of avilable specialized positions in the Services to utilize the highest competence of all the scientists supplied by the various procurement methods. Thus categories 1, 2 and 3 (figure 4) are considered to represent a relatively satisfactory utilization since even No. 3 utilized at least some of the individual's technical background. Categories 4 and 5 represent ineffective and negative use of the scientist's technical competence.

Analysis also indicates that a respondent who was drafted or who voluntarily enlisted had two chances in ten of utilizing his technical background at his level of competence during his military service. A Reserve officer had three chances in ten of utilizing his full skill. Scientists who entered the Service by means of a direct commission had four chances in ten of being used with full effectiveness. When these conclusions are viewed in the light of the widespread technical training and educational programs supported by the Services during the war, it is apparent that personnel procurement, classification, allocation, and management methods left much to be desired. This could not fail to be costly to the national wartime technical military activities. *If the available scientists were not fully utilized it is questionable if the fields of technology which they represented were applied effectively to the prosecution of the war.*

An attempt is also made to compare wartime technical use of scientists in civilian employment with their utilization while in uniform. The questionnaires answered by the civil and mechanical engineers bore identical category tables for both modes of employment. These were checked by the individual respondents. The results indicated good utilization of 86 percent of the engineers while employed as civilians; for those in military service the comparable figure was 50 percent. If the first three categories were used for comparison, the civilian percentage was 94 percent; the military percentage was 73½ percent.

In addition to the information given in the preceding figures concerning utilization, approximately one-third of the scientists who experienced military service gave constructive suggestions or comments concerning better technical utilization, or recommended organization and procedures for better allocation in event of another emergency. These are summarized in highly simplified form in figures *A* and *B*. (Page 23).

Most significant in figure A is the large percentage of scientists who recommended that better assignment procedures and more effective technical use and supervision of their work would have been desirable. A second major category of opinion reveals that a considerable number of these men feel that scientists should not enter the Armed Services during a period of emergency but should work entirely as civilians. It is believed that this attitude was expressed primarily by scientists who were not utilized effectively during their military service.

Five significant conclusions may be drawn from figure B. First, a uni-

SCIENTIFIC FIELDS OF MILITARY RESPONDENTS

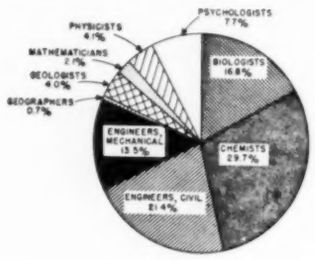


Figure 2 summaries the distribution by scientific field of the 15,157 scientists who reported military service. Approximately one-third were civil and mechanical engineers; approximately one-third were chemists; the remainder were distributed irregularly throughout the other six basic fields of science.

METHOD OF ENTRY INTO MILITARY SERVICE

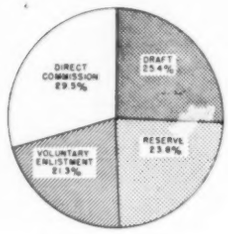


Figure 3 represents the method of entry of scientists into the Armed Services. It is noteworthy that the largest single category of entry was by means of direct commission. The second largest was by means of the draft and the third from the Organized Reserve.

DEGREE OF UTILIZATION OF SCIENTISTS IN MILITARY SERVICE

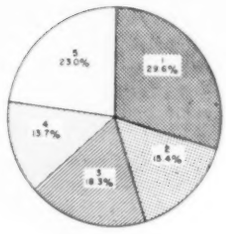


Figure 3
Categories
1. Well utilized
2. Scientific skills half time
3. In collateral field
4. Small portion of time
5. None

versal dissatisfaction with the operations of the Selective Service System as it relates to scientific manpower is clearly indicated by the fact that only 0.04 percent of nearly 5,000 scientists recommended its retention. Second, the scientists strongly recommended some type of national agency to allocate and assign scientific manpower. They suggested the establishment of an improved national roster of scientific and technical personnel, use of the technical societies, or universal national service legislation. Third, there was a strong plea for the establishment of a more effective Reserve program to consist of peacetime training for possible mobilization assignments and a shifting of scientific personnel into branches of service more appropriate to their professional and technological training. Fourth, there was a considerable body of opinion which urged the direct commissioning of all technical and scientific personnel and the assignment of a rank appropriate to the competence, training, and experience of each person recommended. Finally, a considerable number of these scientists urged a modification of Selective Service to make it really scientific. This recommendation corroborates the first conclusion mentioned above, and is perhaps closely related to the second opinion in which some type of a new selection system is suggested.

Recommended Actions

Policy, organization, and procedures which will lead to equitable allocation of the scientific population on a national scale will be necessary for the effective prosecution of any future war.

Numerous facets of the national scene must be considered.

First and foremost, the Military Services must be supplied with an adequate number of professional scientists and engineers, both civilian and uniformed, to perform their technical missions.

Second, adequate numbers of physicians and supporting personnel such as radiologists, bacteriologists, and sanitary engineers, must be reserved in civilian status to maintain the national health.

Third, a sufficient number of civilian engineers and scientists must be assigned to operate communication and transportation systems, and light-and-heat facilities.

Fourth, industry must utilize scientific manpower to carry on research, development, testing, and production to support the war effort and the civilian economy.

Fifth, various non-military governmental agencies must continue their scientific activities.

Sixth, educational activities must be continued on a reduced but significant scale so that we do not sacrifice the long-range welfare of the country to short-range needs.

The activities of any war period make unparalleled drains on the technical economy of the nation. Great care must be taken, therefore, to mobilize the national scientific resources in such a way that they make the greatest contribution possible to the war effort. It is essential, in accordance with general policy decisions reached at the highest levels of government, that procedures be devised which will insure the effective distribution of scientists to all categories of the national economy. Hand in hand with this procedure, it is imperative that the users of these personnel, that is, industry, education, the Armed Services, etc., utilize the greatest care to insure that their supply of scientists reaches as far as possible in the same way that they would conserve any other valuable and scarce resource.

Overcoming Inadequacies

The survey upon which this report is based shows that the procedures utilized for the mobilization, allocation and use of scientists during World War II possessed many shortcomings. There appear to have been three major inadequacies—

1. A lack of adequate planning on a national scale.

2. The wrong type of national allocation procedures for scientists.

3. Inadequate means for classification, assignment and use of scientists within the Armed Services.

To overcome these deficiencies, it would seem reasonable to use the same general approach now being applied to planning for the mobilization and use of industrial facilities or for estimating our resources of strategic minerals.

The enormous expansion of research, development, and other technical activities in the United States within recent years has led to an unprecedented demand for scientists. Owing to our unrealistic draft policies during World War II and the present large demand for trained scientists, we still have severe shortages in some fields. However, the return of large numbers of veterans to college enhanced by resumption of the normal flow of college students is now leading to the graduation of large numbers of scientific students from colleges and universities. Dependent on the requirements of industry and the Armed Services, the shortages in many fields should be eliminated by 1951.

Even though we can prophesy the approximate output of trained men in the next three years, we have no means of making realistic national estimates of our future requirements for scientific manpower. For all we know at present, the year 1955 may find some fields oversupplied and others held back because of manpower shortages. There is no central place where information concerning the plans of industry, the needs of our growing populace, or the potential requirements of the Military Establishment can be focalized at the operational level. In order to plan realistically for either future war or future peace, it seems necessary to establish a national mechanism which will be able to evaluate *present and potential supply in terms of present and potential demand.*

As an adjunct to such an office, a catalog of scientists appears to be necessary. Since the various scientific and engineering societies are most familiar with the personnel in the field which each represents, these societies appear to be the logical agents for this task.

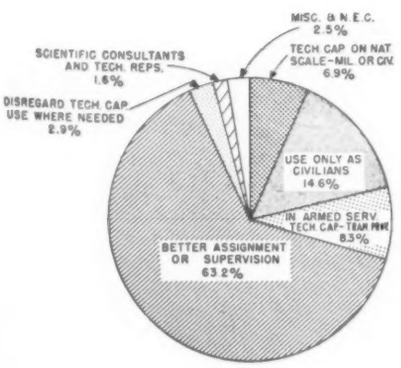
If we expect to utilize scientific manpower in any future national emergency as realistically as we plan to use industrial facilities, we cannot expect to allocate them by lot, age group, or local bulk quotas. It would seem more realistic to make every working scientist responsible for service in the national interest no matter what his age or physical constitution. The scientific manpower pool then could be distributed by the central office which already possesses adequate information concerning the national supply, to either military or civilian agencies in accordance with requirements. This procedure should supply the Military Establishment with the numbers and kinds of scientists required for all types of military activities at the times when they are needed.

The second segment of the problem applies to the use of uniformed scientists by the National Military Establishment during a period of hostilities. Military activities requiring a technical background for their adequate performance have become of great importance to the effective functioning of the combat arms, and in many cases scientists form a part of the combat team. In addition, a wide variety of supporting technical activities which require a professional level of training and experience are now necessary in the noncombat agencies of the services. These may include such widely varied activities as research and development, operations research, combat evaluation of new devices, or the maintenance of communications.

It is to the advantage of the services to apply the most modern advancements in technology to their combat and noncombat functions. This will require that the applications of known technology to military activities be constantly scrutinized. This process is basic to improvement in technical functioning and to proper use of scientific personnel resources. Once the application of science has been determined, the role of the scientist has been defined. It then remains to establish processes to identify, evaluate, and assign the scientist to the job his technical competence fits best. In order to do this effectively, it would seem appropriate to establish an office within each of the departments of the NME, specifically empowered and staffed to carry out necessary scientific manpower research, planning and operations. Under the principle of unification, the activities of these offices could be coordinated and broad policy delineated from the level of the Secretary of Defense or the R & D Board.

Figure A

UTILIZATION SUGGESTIONS FOR BETTER USE OF SCIENTISTS


MISC. & N.E.C. 2.5%
SCIENTIFIC CONSULTANTS AND TECH. REPS. 1.6%
TECH CAP ON NAT SCALE–MIL OR CIV 6.9%
DISREGARD TECH CAP USE WHERE NEEDED 2.9%
USE ONLY AS CIVILIANS 14.6%
IN ARMED SERV TECH CAP–TEAM WORK 8.3%
BETTER ASSIGNMENT OR SUPERVISION 63.2%

Recommendations of Scientists

A portion of each questionnaire answered by respondents who reported military service referred to the experience of the individual in terms of the utilization of his technical background while in uniform. For example, the questionnaire sent to all members of the American Chemical Society asked:

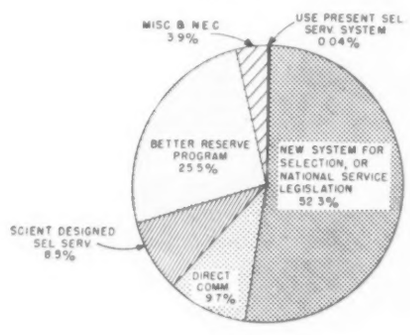
a. Give comments on your military service with reference to—
   1. Effectiveness of your chemical work in World War II.
   2. Suggestions for better utilization of chemists in time of national emergency.

Large numbers of the respondents submitted replies to those questions

Figure B

ORGANIZATION AND PROCEDURE SUGGESTIONS FOR BETTER UTILIZATION OF SCIENTISTS

Most significant in Figure B is the large percentage of scientists who recommended that better assignment procedures and more effective technical use and supervision of their work would have been desirable. A second major category of opinion reveals that a considerable number of these men feel that scientists should not enter the Armed Services during a period of emergency but should work entirely as civilians. It is believed that this attitude was expressed primarily by scientists who were not utilized effectively during their military service.


MISC. & N.E.C. 3.9%
USE PRESENT SEL SERV SYSTEM 0.04%
BETTER RESERVE PROGRAM 25.5%
NEW SYSTEM FOR SELECTION, OR NATIONAL SERVICE LEGISLATION 52.3%
SCIENT DESIGNED SEL SERV 8.9%
DIRECT COMM 9.7%

* * * The pattern of summarization is divided into two major categories, namely (1) Utilization and (2) Organization and Procedures. This pattern was devised through original analysis of approximately one thousand opinions and was found subsequently to include all the variations of comment submitted.

Utilization

Assignment and Supervision. More than one-half of the respondents emphasize the need for better methods of assignment or supervision of technical personnel in uniform. The emphasis varied from 80 percent of the respondents in the field of biology to 35 percent in the fields of geology and psychology.

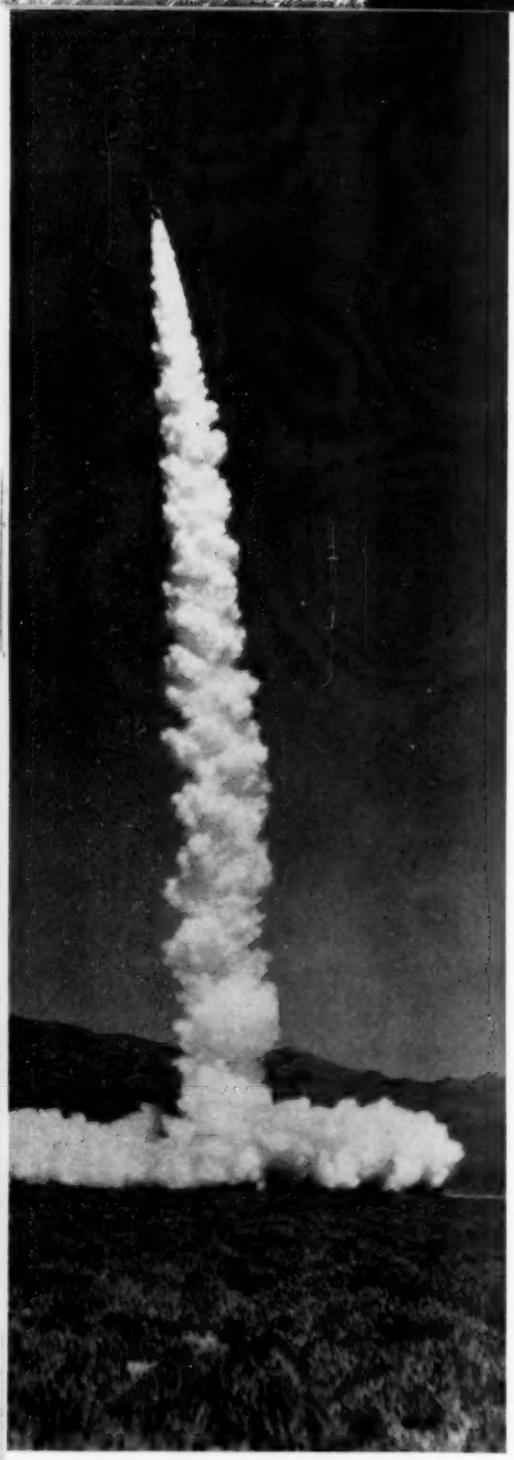
Utilization as Civilians. The second largest category of opinion concerning utilization suggested that scientists and engineers should be used only as civilians during a period of hostilities. Many of these men felt very strongly that professionally trained scientists and engineers could make a much greater contribution to the national welfare as civilians working on research and development projects than as officers or enlisted men in uniform. Some of the comments were vitriolic and bitter; large numbers marshaled arguments carefully; but all lost sight of the fact that *any future war will require within the Services a large group of technically trained officers of high skill to function in research planning and operations.*

Transfer Within the Services. Another large series of recommendations concerning utilization dealt with the matter of transfer within the military system or release from military service in order to insure better technical utilization of the individual. Many respondents reported that they had been assigned to relatively nontechnical duties at the same time that the Services were recruiting professional scientists and engineers through publicity campaigns, but that their requests for transfer to these more technical branches were refused by commanding officers.

Technical Training Programs. A considerable number of comments were offered concerning the malutilization of fully trained and experienced scientists concurrent with Service operation of training programs in these same fields. In addition, rather numerous comments mentioned the nature of the training and the caliber of instruction in training courses operated by the Services.

Rank Based on Technical Competence. The assignment of rank based on technical competence was brought

(Continued on page 34)



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The history of World War II makes it obvious that warfare is becoming increasingly technical. There are even those hysterical individuals who attempt to describe future wars in terms of a technical exercise fought at long range and without benefit of a normal military organization. More realistic and sober thinkers, however, correctly evaluate future warfare as one in which the technological aspects will be extremely important, but which will also call for ground armies in the general sense in which we have always known them. They also recognize the vital role which scientists and engineers will play in such a conflict.

In this connection, let us first consider how we may determine where the technologist will be utilized in any future emergency. As a basic assumption let us assume that war will be more technical; that our cities will be bombed; that our production will be interrupted in part by this bombing; and that a pattern of research and development somewhat similar to that carried on in World War II will be undertaken.

In such a situation we must first make sure that the Armed Services are supplied with the requisite number of technologists; that they are assigned to the proper spaces and are given an opportunity to apply their technical skill to the greater effectiveness of military operations. If we are to do this realistically, we must first examine the proposed activities and functions of all military agencies in terms of the technology which is available and which can be applied profitably to their operations. Conversely, the technologists with military experience must examine their subject matter fields in terms of their application to military operations. When these two bodies of information have been collated, and if the analysis has been undertaken carefully and objectively, the Armed Services should have at their disposal an entirely new and very useful body of information.

Based upon the results of these analyses the Armed Services should be able to estimate their requirements for technologists rather accurately. It must be borne in mind that the wartime activities of many of these individuals will be directly connected with combat operations; others will operate in the zone of communications; and large numbers will work in the zone of the interior either as uniformed personnel or as civilians. Assignments will embrace a wide variety of activities from basic research through development to testing and production, operations research, intelligence, civilian defense, scientific planning, technical field evaluation in the combat zone and participation in direct combat. The effectiveness of these technical operations will be dependent on the technological calibre of the individuals, the effectiveness of planning and organization, and the character of the devices and weapons which are available.

Planning for Future Defense

In view of the international situation and the political dichotomy of the modern world, it is rather apparent that any possible future war will also find the United States con-

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siderably outmanned. During the 160 years of our existence as a nation we have seriously depleted our domestic raw resources. We have never had adequate domestic supplies of several strategic materials and have been forced to depend on importation. Unless the technologists can develop adequate substitutes or much less wasteful methods of waging war than have been obtained hitherto, future warfare will find us in difficulties because of inadequate supplies of raw materials. Thus, such war will not only use devices of much greater technical complexity than formerly, but we will be forced to depend for survival on our technical superiority. If World War II was a criterion, our technical manpower resources will be stretched to the absolute maximum.

This would suggest that effective planning for future national defense should insure that we husband and plan for the use of technical manpower as carefully and conscientiously as we will for the use of production facilities or materials. In the case of the latter, assiduous and unified planning is now going forward. In the case of the technologists, however, there has been little attempt to make the same realistic evaluation of supply against demand or to adopt policies calculated to stretch the supply as far as it possibly can reach. Such activities as are in process are inadequate and uncoordinated.

During the past war in accordance with our sound and traditional democratic policies, we subjected technologists to the normal draft process. The results of a recent study of the military utilization of 15,000 scientists and engineers during World War II indicates that this resulted in a considerable waste of technical manpower. In general, men who were commissioned directly for specific functions were well used. Those who held Reserve commissions prior to the war were only fairly well used, largely because they were called to active duty in the basic branch of their Reserve commission which did not necessarily reflect the character of their civilian skills and experience. This was probably caused in large measure by the circumstance that these individuals had taken Reserve commissions in the basic branches represented by Reserve training units on college campuses, and inadequate consideration of their subsequent training and experience had been given either in maintaining their basic branch assignments or in designating their mobilization assignments. Part of the responsibility for this situation must be logically placed on the individuals themselves who did not request transfers.

Need for a Policy

The technical utilization of technologists who either were drafted or voluntarily enlisted was poor. Almost one-half of these individuals performed little or no technical work while members of the Armed Services. Many of them could not be granted commisions and placed in positions of responsibility or in activities commensurate with their training and experience because tables of organization did not call for additional commissioned personnel or because they had minor defects of personality or physique which prevented them from meeting the rigid officer requirements. It would seem reasonable in any future emergency, when all our national resources will be taxed to the limit, to utilize these scarce individuals much better than we did before. Since technologists are needed in wartime in both the military and civilian spheres it would be no great loss to the Armed Services to discharge a technologist with personality defects which would make him a poor soldier or sailor and return him to technical civilian work supporting the war effort where he might make a much greater contribution. For those individuals with adequate personality qualifications, but lacking the high physical qualifications required for combat service, it would seem reasonable to commission them in accordance with the needs of the Services and to place them in non-combat positions where their skills and experience could be adequately utilized. If these men are professionally successful in civilian capacities, there seems to be no reason why they would not be similarly successful in military activities which are physically no more onerous than those to which they are accustomed.

If such a policy were followed considerable numbers of individuals who were kept in the ranks during the past war and were not utilized well could be utilized to their fullest extent. This would also release large numbers of physically adequate individuals for more arduous service.

But such a provision for the use of limited service technologists would not solve the basic problem which we face both nationally and within the Armed Services so far as the applications of technology and technologists to warfare is concerned. We are dealing with less than 1% of the population of the United States. At the professional level this involves probably less than one-half million individuals. The entire technical effort of the nation depends on the adequate application of their skills to the technical problems at hand. During any emergency they must be divided between the military service; national health activities; industrial functions; special wartime research and development; maintenance and operation of heat, light and communication facilities; continuation of non-military governmental research and development; and education. If the civilian activities are not to disappear and if the technical military functions are to be made most effective, every man must make his maximum contribution to the national good. This will not be possible if we follow our example of World War II when we allocated many of these individuals essentially by lot or in accordance with the decisions of technically uncomprehending local Selective Service Boards. For in this way a considerable number of these individuals were presented to the Armed Services at a level at which their professional utilization was almost imposible, or perhaps they were inducted at times when their technical skills were not needed by the Services, and therefore were shunted into activities which failed to use their scarce technical competence.

A "Delicate" Task

The establishment of procedures and policies which would insure the effective utilization of this very small but vital component of our population is a delicate and complicated task. It is delicate in the political sense because it forces us to accord special treatment to a very small segment of the population. Yet there is precedent in the treatment of physicians during the past war, in the deferment of agricultural workers and in the special but very small wartime roster of OSRD scientific workers. There is also precedent in the example of our British allies during World War II. The situation is complicated by the complexity of skills represented and the necessity for special allocation procedures.

But the problem is not one of deferment. The statistics at hand indicate that technologists do not wish to be deferred from service. Rather they wish to serve where they can be most effective in the national defense effort. How then may we divide this scarce manpower commodity among the competing interests which must utilize it, and at the same time cause it to assist any national war effort to the maximum?

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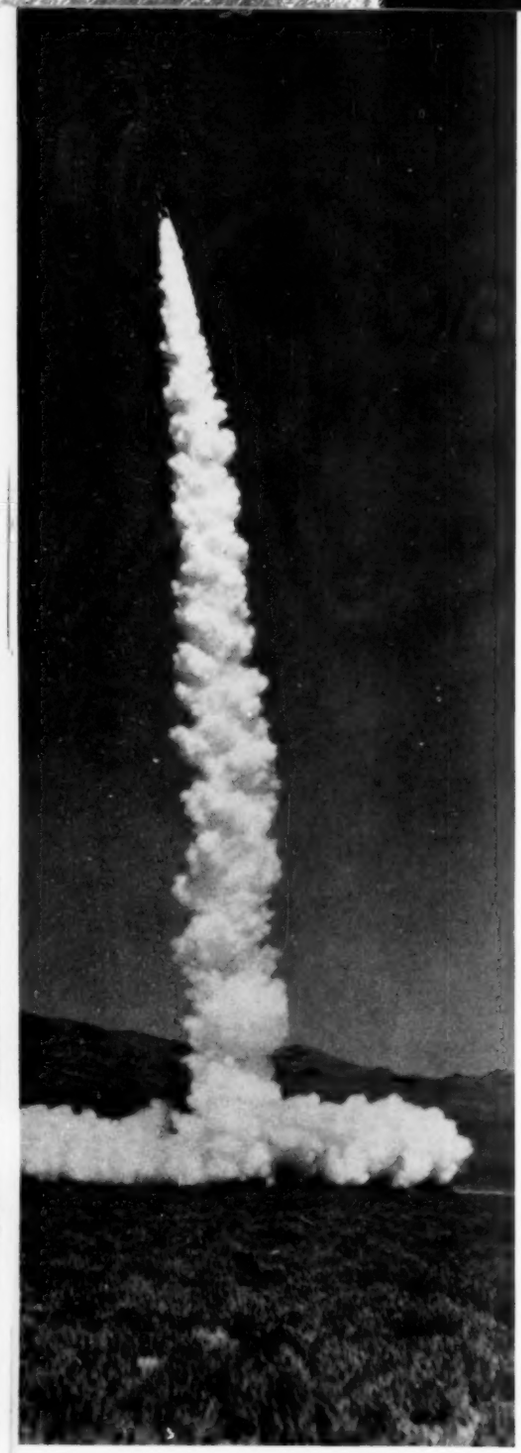

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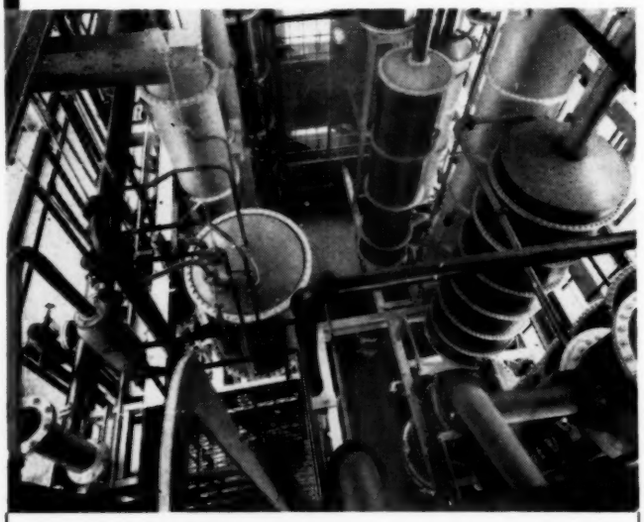
has served the Process Industries for forty-seven years, and throughout this period has been engaged exclusively in the highly specialized fields of Distillation, Evaporation and Extraction. Below is a representative list of chemicals now being processed in Vulcan-designed plants and equipment:



ALCOHOLS
Methanol — synthetic
Methanol — from wood distillation
Ethanol — industrial grades from molasses and grain
Ethanol — from sulphite waste liquor
Ethanol — anhydrous, Vulcan process
Ethyl alcohol — beverage, neutral spirits, beer
Isopropanol
Allyl alcohol
Butanol

ESTERS
Methyl acetate
Ethyl acetate
Isopropyl acetate
Butyl acetate
Vinyl acetate
Dibutyl phthalate
Methyl methacrylate

ALDEHYDES
Acetaldehyde
Butyraldehyde
Furfural

ETHERS
Ethyl ether
Isopropyl ether

DDT

KETONES
Acetone
Methyl ethyl ketone

GLYCOLS
Ethylene glycol
Butylene glycol

CHLORINATED HYDROCARBONS
Chloroethane
Chlorobenzenes
Chlorotoluenes
Trichlorethylene

HYDROCARBONS
Butadiene
Heptane
Benzene
Toluene
Styrene
Diphenyl
Hexane
Alkyl Benezenes

ACIDS
Formic acid
Acetic acid — from wood distillation
Acetic acid— from process residues and solvent recovery
Acetic anhydride
Propionic acid
Butyric acid
Stearic acid
Monochloracetic acid
Salicylic acid
Fatty acids

PHENOLS
Phenol
Naphthol

MISCELLANEOUS
Citronellal
Geraniol
Essential oils
Aniline
Monethylaniline
Diethylaniline
Oxygen
Hydrogen
Arsenic trichloride
Waste sulphite liquor

Vulcan distillation evaporation extraction processes and equipment

COMPLETE ORGANIZATION SERVICE

• PILOT PLANT • PROCESS DESIGN • MECHANICAL DESIGN
• SHOP FABRICATION • FIELD ERECTION • INITIAL OPERATION

THE VULCAN COPPER & SUPPLY CO., General Offices and Plant, CINCINNATI, OHIO

SAN FRANCISCO NEW YORK BUENOS AIRES

IN CANADA — FICKERS VULCAN PROCESS ENGINEERING COMPANY LTD — MONTREAL

CHAPTERS

Army Chemical Center Chapter

Information concerning the activities of the Army Chemical Center Chapter did not reach the *Journal* in time for publication in the last issue. Three of the Chapter officers who were elected in 1948 resigned because of the pressure of other duties and replacements were elected by the Board of Directors. The present officers are: President, Mr. L. Wilson Greene; First Vice President, Mr. Fred B. Shaw, Jr.; Second Vice President, Mr. Henry C. Fischer; Secretary-Treasurer, Mrs. Marie Klug. Col. John A. MacLaughlin, Lt. Col. Thomas A. Carilia, Mr. Edmund H. Schwanke and Mr. Lawrence M. Phelps are members of the Board of Directors. Mrs. Anne W. Shipley is Chairman of the Entertainment Committee.

The Chapter has had a very successful year. A membership drive was launched in December under the leadership of Hen Fischer, Chairman of the Membership Committee, who was ably assisted by Col. Tom Carilia, a member of the National Membership Committee. We had 288 members at the beginning of the drive and as of 23 February, 1949, the number of paid-up members reached a total of 556. This remarkable achievement is a tribute to the hard work of the chairman, committee members and others who belong to the Chapter. Each new member receives a personal welcoming letter from the President of the Chapter, and all members are kept advised concerning the activities and decisions of the Board of Directors.

On 2 February, the Chapter gave a cocktail party for all members. Held at the Gunpowder Mess it was attended by 183 members and 42 guests. Honorary guests included Brig. Gen. and Mrs. E. F. Bullene, Col. and Mrs. Ludlow King, Mr. Fred Jacobs and Capt. MacArthur H. Manchester. —L. Wilson Greene

New York Chapter

The New York Chapter held its regular meeting in February at the Officers Club of New York. The Chapter, prior to the meeting, entertained informally those attending which included prominent members of industry and of the Chemical Corps. Among those present were General Porter, Colonel Kuhn and executives of the major chemical companies.

After a short business meeting, Col. Henry A. Kuhn, President of AFCA, addressed the group giving a brief report on the status of the association. Col. J. F. Escude, commanding officer of the NYCD outlined the Chemical Corps Procurement Program for the balance of the current year which he felt would be of definite interest and value to members of industry attending the meeting. The guest of the evening was Senator Albert V. Hawkes who gave an informal but exceptionally interesting talk on the present economic situation in this country and its relationship with the current world situation. Prior to accepting the senatorship from the state of New Jersey, Senator Hawkes was actively engaged in an executive capacity in chemical industry for over 30 years.

An exceptionally large attendance was indicative of renewed interests in the chapter's activities and paves the way for the New York Chapter to reestablish itself as one of the important cogs in the Armed Forces Chemical Association. —Charles H. Brinkmann

GROUP AND SUSTAINING MEMBERS

ARMED FORCES CHEMICAL ASSOCIATION

Chemical and Related Industries

ABBOTT LABORATORIES, North Chicago, Ill.
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Chapter .....

MEDICINE FROM MUSTARD GAS

By Capt. John Lawson, CmIC-Res.*

Ever since July 1917, when the Germans first used mustard gas at Ypres, Belgium, the tactical employment of chemical agents in warfare has posed an ominous threat to both aggressor and defender. But more than thirty years of concentrated scientific research were destined to produce constructive results along with those intended for destruction. Now on a modest scale we see derivatives of mustard gas being tried in the treatment of certain types of cancer-like disorders, and medical applications are being found for other chemical compounds of war.

To get an insight into the possible implications this program may hold for the future, let us look at one of the theories being followed in a leading cancer center, the Sloan-Kettering Institute in New York City, which is the latest in facilities for clinical investigation into the mysteries of neoplastic (abnormal growth) diseases. Part of the work at this organization is based on the knowledge that the mustard gas molecule is composed of two like chains of carbon, hydrogen, and chlorine molecules joined together by a sulfur molecule. Derivatives of mustard gas are produced by substituting for sulfur other molecules or combinations of molecules to connect the two simple chains that form the base of the mustard molecule. Thus, the variety of derivatives which may be made is as great in number as there are combinations which may act as links for the two chains, but unfortunately many of these derivatives are clinically of no value, so the search is along limited lines.

Scientists are busy testing the physiological effects of a certain few of these more promising compounds against malignant, cancerous growth, according to a well formulated program supervised by The American Cancer Society. The group of mustard derivatives that so far has proved effective against cancerous diseases comprises the nitrogen mustards in which the basic chains are joined by nitrogen, plus other chemical elements. In the one nitrogen-mustard which thus far has been shown to be most effective against certain neoplastic disorders, these other chemicals are a carbon-hydrogen combination known as a methyl radical. This agent is called methyl-bis(beta - chloroethyl)amine and is one of the many possible beta-halogenated amines.

* * *

Before mustard gas was used in combat in World War I, it was not known that it had a selective action and was especially harmful to areas of rapid growth within the human body, such as the intestinal tract and the blood-making organs. This selective effect of nitrogen mustard was discovered during World War II, so it was natural, then, that its compounds should be tried medically against unwanted, rapidly growing tissue. Since cancer is fundamentally a growth of misbehaving cells which for some reason don't belong where they happen to grow, cancerous tissue and related diseases appeared to be ripe for experimentation with mustard gas or some of its less toxic derivatives. Now it is postulated that nitrogen mustards may inhibit cell division by a complex cellular, enzymatic action and thus arrest the growth of undesirable tissue or cells. But regardless of the precise mode of action, after painstaking laboratory and clinical research, it has been established that a nitrogen mustard (methyl-bis) does have a beneficial effect in the treatment of some cases of Hodgkin's disease, a tissue derangement named after its English discoverer, Dr. Thomas Hodgkin (1798-1866).

This is an inflammatory, neopastic condition which produces enlargement of the body's lymph glands. It usually starts in the neck and eventually progresses, unless checked, to other lymph nodes. It is accompanied by cough, fever, and anemia in many cases. Diagnosis can be ascertained by surgery to obtain affected tissue for microscopic examination. Fortunately, this is a relatively uncomplicated procedure if the disease is suspected and detected early in its course. It should be kept in mind that treatment with methyl-bis, while promising, is not the final answer. Nitrogen-mustard is definitely not a cancer cure and should not be thought of as such. However, its results, when compared to results with other forms of palliative treatment, have been sufficiently favorable to warrant its repeated use in selected cases, and to justify further research on allied compounds.

In one series of 27 Hodgkin's disease patients under treatment from 3 to 33 months, 9 recovered adequately to return to work, which in itself is worthy of note. Eight died because the disease was extensive at the beginning of therapy, and results were variable in the other 10, many of whom noted prolonged remissions in the progress of their disease even though relapses usually occurred. These remissions could be made to recur by further courses of methyl-bis when symptoms reappeared. The average course of treatment is generally regarded to consist of four intravenous injections of the drug in daily amounts proportionate to body weight.

Evaluating the success of the injections necessitates various tests, so hospitalization is required. Physicians have to have complete case histories including radium-ray response, blood chemistry, spinal fluid analysis, urinalysis, and basal metabolism measurements. If these numerous determinations seem to be long and drawn out, remember that Hodgkin's disease frequently is a fatal and usually painful affliction, only some cases of which heretofore have responded to radium-ray therapy or arsenic,

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and then, in certain instances, only when treatment was more or less continuous. That methyl-bis is not the final answer to the problem is seen in the toxic effects of the drug, but because it is a chemical form of treatment and not surgical or physical, there is indication that progress is being made in the proper direction.

Toxic reactions in patients include nausea and vomiting for 2 to 4 hours occurring within a few hours after injection, and there are blood changes which usually are only temporary. Liver and kidney function is not so generally influenced as might be expected with the type of blood count changes that take place. Despite these complexities, results have been fairly striking in some cases of Hodgkin's disease in which methyl-bis has been tried.

Frequently, alleviation of fever and weakness, reduction in size of enlarged liver, spleen, and lymph glands, and general symptomatic improvement are rapid and almost dramatic. Some remarkable results have been reported by doctors who observed a few cases in which radium therapy was ineffectual. One of the primary advantages of a drug is that it is easier to administer than radium in situations where the disorder is deep-seated within the body. The technicians who face the task of trying these numerous different mustard compounds on induced neoplastic diseases in laboratory animals are sufficiently encouraged by results so far to speculate that a relatively non-toxic, effective substance may be eventually uncovered.

Physicians also have successfully used methyl-bis to treat other tissue disorders. Eight out of 9 cases of lymphatic leukemia responded well according to one report. This illness, similar to Hodgkin's disease, is characterized by enlarged nodes, bone tenderness, skin pigmentation, and anemia in later stages. Relapses also were noted in these patients, but here again, relief was obtained by successive courses of treatment. Methyl-bis has been observed to dispel the symptoms of polycythemia rubra. Manifested by constantly congested and flushed skin and enlarged spleen due to overactivity of the factor in bone marrow which produces red blood corpuscles, polycythemia is not a widespread disorder but nevertheless is a highly debilitating one. Probably you have seen people with lupus erythematosus. Their bodies, and particularly their faces, are marked with dusky red, thick, scaly, skin lesions and they suffer from the spleen enlargement, irregular fever, and anemia which are typical of the neoplastic sickness. Some of these individuals are being given hope for new palliative treatment by methyl-bis. One case of lupus was under various forms of treatment for three years with virtually negligible results. Methyl-bis was instituted and the ugly dermatitis subsided to merely a few skin patches in a period of three months. In 29 cases of primary cancer of the lung parenchyma, 70 per cent experienced clinical improvement when put under methyl-bis therapy. And in a case of fungus infection known as mycosis fungoides of four years duration in a 79-year-old man, skin symptoms were appreciably decreased in less than two weeks. An infection of this type, although relatively rare, could affect any one of us and might involve both internal and external parts of the body. Almost the entire skin area in the case under discussion was marked by unsightly sores.

While it may be some time yet before the average patient will be able simply to take medicine for various types of cancer, Science appears to be at long last working on a promising lead which conceivably could reveal some of the hidden secrets about the treatment and eventual prevention of one of mankind's greatest scourges. If one of these many mustard derivatives should prove to be a key that will lead directly to further answers, a chemical of combat will have made an important contribution to the advance of the science of medicine.

A second wartime chemical compound that is being applied successfully to human sickness is BAL, or 2, 3-dimercaptopropanol. BAL derives its popular designation from the phrase "British Anti-Lewisite." It was developed in England for protection against warfare chemicals containing arsenic, particularly Lewisite, a destructive agent designed to produce combat casualties by blistering the skin, irritating the lungs, and poisoning the system. BAL was supplied for troops as an ointment not only to arrest but also to prevent skin changes due to arsenic agents. It may be said that the constituents of BAL compete with body tissue proteins for the arsenic in such agents and possibly cause arsenic molecules to split off from protein molecules and form a non-poisonous, stable substance of which the body can rid itself.

In civilian life, arsenic poisoning may come about as a result of syphilitic therapy in which aresenic is used, or from overexposure to arsenic metal in industrial processes. Syphilis treatment, if the patient should show a sensitivity to the arsenic-containing drug being used, may result in a severe dermatitis or a form of neuritis affecting vision. BAL improved the skin condition in three days in one group of cases of this type, and the optic difficulty was cleared up promptly. Other symptoms of arsenical poisoning, such as jaundice, fever, blood changes, and even encephalitis or brain inflammation, show a high degree of recovery with BAL therapy.

The side effects of BAL including nausea, vomiting, headache, salivation and a feeling of burning in the hands and feet, usually are controllable by barbiturates. More often than otherwise, the risk of slight side reactions is worth the chance of relief from the distress of arsenic poisoning.

Research workers have known for some time that the processes involved in arsenic poisoning are similar to those that take place in the case of poisoning with other metals of the same classification. So it was natural for them to try BAL for the poison effects of mercury, gold, and lead. When the human body is exposed for long periods of time to an atmosphere of vapors of these metals, the blood takes up the metal, and it is believed that it is then deposited in the bones. In order to rid the body of the metal, BAL is given to form stable compounds (as in the case of arsenic) which will re-enter the circulating blood and be carried off as waste. Results in cases of mercury poisoning, have been much more outstanding than in cases in lead poisoning, but in one instance of the latter, a man who mixed paints in a poorly ventilated location for many years, suffered a syndrome consisting of internal pain, weakness, nausea, and diarrhea. His teeth showed a discoloration, or so-called "lead line," and urinalysis revealed that lead was not being discarded by his system. After a series of BAL injections, he felt well for the first time in many weeks and his lead urine indicated that his body was successfully throwing off the poisonous material.

Gold compounds frequently are used in the treatment of arthritis, but once in a while a patient is discovered who shows a toxic reaction to gold, characterized by skin and blood changes, mouth ulcerations, and eye inflammation. Here again, BAL removes gold from the tissue protein molecules by forming a stable, disposable compound. When this hap-

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PLASTICS FOR THE CHEMICAL CORPS*

By Fred B. Shaw, Jr.

Chief, Engineering Division Technical Command
Army Chemical Center, Maryland

Prior to the so-called emergency period preceding World War II, the Chemical Corps made little use of plastics in the design of materiel. With the increased activity brought about in military research and development by that emergency, more and more attention was paid to plastics as a material of construction.

One of the first plastic articles developed by the Chemical Corps was a molded, cylindrical lens for use in gas masks. This lens, which was eventually used in all the more than 25,000,000 masks produced during the war period, was one of the most satisfactory applications of plastics accomplished at that time. Not only was a good optical item obtained within the close tolerances of plus or minus one-fourth of one diopter, but the development represented the correct use of plastics in design in that it produced a useful item not obtainable from any other material then available; since glass itself was not satisfactory for the application, and the problem of manufacturing cylindrical, optical-quality lens of laminated glass had not then been successfully solved.

After this encouraging beginning, however, other engineering uses of plastics by the Chemical Corps during the emergency period were not always as well conceived. Most of these applications made use of plastics as substitutes for metal rather than for their own inherent properties. The various angle tubes, outlet valve guards, valve seats, and diaphragm assemblies for military and civilian gas masks were created from thermoplastics during this period, and subsequently proved not to be entirely satisfactory under field conditions. It is, of course, not startling to find that the Chemical Corps was using plastics mainly as a substitute during this period since industry as a whole was guilty of this approach to plastics utilization at that time; partly because of lack of experience in engineering applications of plastics, and partly because of the fact that metal shortages made the use of substitutes mandatory.

During the period of the war itself, the peculiar properties of special plastics became more and more appreciated, and material design taking advantage of these characteristics became increasingly the rule rather than the exception. In this period the Chemical Corps conducted extensive development work on plastic bomb bodies; individual protective covers; compression molded phenol-formaldehyde fuzes for the 4.2 inch Chemical Mortar Shell (Fig. 1); plastic spray tanks for the dispersion of chemicals from aircraft; vinylite, urea-formaldehyde and cast phenolic containers for corrosive chemicals; ethyl cellulose eyeshields; and cellulose nitrate powder containers for use in the ignition trains and explosive systems of all types of smoke, chemical and incendiary munitions. The M1 Fire Starter, consisting essentially of gelled gasoline contained in a cellulose nitrate body, was produced at this time (Fig. 2), as well as the first plastic ignition cylinder bodies for use in flame throwers (Fig. 3), and numerous calculating devices for such uses as mortar fire control and gasoline thickening operations in the field. Also, a gas mask consisting almost entirely of polyvinyl chloroacetate, for hospital patients suffering from head wounds was developed.

In addition to the moded and fabricated items already enumerated, resins, paraticularly alkyds, were successfully applied to fabrics for the preparation of vesicant-gas-resistant garments. Other resins were used to thicken toxic agents so as to enhance their physical properties for military uses. Further, the use of plastic materials in the packaging of military items was expanded tremendously, particularly in regard to strippable corrosion-prevention compositions, low moisture-vapor transmission films, and containers resistant to corrosive chemicals. As an example of the latter type of investigation, certain polyvinyl alcohol and polyvinylidene (Saran) films were found to be the only available materials for the construction of sacks resistant to the action of semi-stable organic chlorine-containing compounds.

Since the war the Chemical Corps' interest in the field of plastics has continued to grow. An item recently put into large-scale production is a riot grenade manufactured almost entirely from phenolformaldehyde plastic, (Fig. 4).

Another interesting post-war application of plastics, insofar as the Chemical Corps is concerned, has to do with the filling of military shell, rockets, and bombs with

*Address delivered before a recent meeting of The Society of the Plastics Industry.

Fig 1—4.2" Chemical Mortar Fuze. This particular sample prepared from methyl methacrylate resin for illustration purposes only. Actual limited production of this item from a Bakelite molding compound was accomplished during World War II.

Fig. 2—M1 Fire Starter. Consists of a cellulose nitrate body filled with thickened gasoline.

Fig. 3—Typical phenol formaldehyde ignition cylinder body.

Fig. 4—Spherical M25A1 Grenade viewed from

toxic agents. Generally these munitions are filled through an opening which is subsequently sealed by the assembly of a burster tube or burster tube well. When toxic agents are of the high-boiling liquid or solid types, contamination of munition bodies and threads in or near the filling orifice almost invariably occurs, and extensive cleaning by the use of solvents, steam and/or wire brushing have been found necessary to insure subsequent safe handling of the items. Such hand processes are time-consuming and expensive. To overcome this difficulty, it was found possible to formulate a strippable coating, based on cellulose acetate butyrate, which can be applied to the threads and other surfaces near the filling point in such a manner that, after filling, the contaminated strippable plastic can be removed in one simple operation, leaving the filled munition safe for handling without further precautions. The contaminated, plastic protectors having been stripped from munitions are readily decontaminated, mechanically, in large numbers, melted down, and the material made available for repeated use.

Post-war investigations have also demonstrated the advisability of physically incorporating plastic compositions in certain solid chemical agents to enhance their behavior in the field.

At present the research and development program of the Chemical Corps continues to make maximum use of available plastic materials in the development of materiel and in the packaging of such materiel for storage and shipment under arduous conditions. The evaluation of the many new resins and plastic films in regard to their resistance to the various toxic agents, with a view toward using appropriate plastics in protective clothing, gas mask hoods, gas capes, and miscellaneous packaging operations continues unabated, along with the somewhat corollary investigation of synthetic resin type, enamel films suitable for use in shipping and storage containers for toxic agents and related substances.

Particular effort at this time is being directed toward the replacement of heavy, non-functioning, metallic parts at present used in many munitions, weapons, and protective devices with lightweight, high tensil strength, plastic laminates. The successful accomplishment of these endeavors will result in a decreased "dead" weight in each item, and, in the case of munitions, will make each round more efficient on a weight basis as well as allow for a greater number of rounds per "delivery unit." This latter is of the greatest importance when "delivery" is accomplished by means of aircraft. It is also highly important when "delivery" is made by the individual soldier who, experience shows, tends to discard excessively heavy equipment regardless of its ultimate value to him.

Another field of current Chemical Corps activity has to do with the development of a dimensionally stable, thermosetting, highly inflammable plastic. Such a material will have little or no application commercially, but it is of obvious value from a military standpoint; for example, in replacing non-inflammable structural units in incendiary bombs.

Naturally, items first fabricated from plastic during the war have frequently been improved in design or have been changed from one plastic material to a newly developed composition when improved functioning or storage life could be achieved. And, of course, the successful application of a plastic component in one end item has resulted in the use of a similar material in the corresponding components of other end items—particularly those developed subsequently to the original successful application.

(Continued on page 40)

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BIOLOGICAL WARFARE POTENTIALITIES*

WORLD WAR II RESEARCH INDICATED THAT GERMS OR THEIR POISONOUS PRODUCTS COULD BE USED EFFECTIVELY AS WEAPONS OF WAR. UNFORTUNATELY, HOWEVER, THE PUBLIC HAS BEEN GIVEN AN EXAGGERATED IMPRESSION AS TO THE POTENCY AND STATE OF DEVELOPMENT OF BIOLOGICAL WARFARE.

Editor's note—Owing in some measure to the limitations of official information, discussion of the subject "biological warfare" has, in the opinion of the Secretary of Defense, been "extravagant, inaccurate and unduly spectacular in the light of present scientific knowledge." Accordingly, in mid-March the National Military Establishment issued the following release in order that the American people be given an official statement concerning the potentialities of biological warfare.

Prompted by intelligence reports of enemy activities in the biological warfare field during World War II, intensive investigations of the possibilities and potentialities of biological warfare were initiated in the United States in close collaboration with our British and Canadian allies. These investigations were aimed primarily toward securing for this nation adequate protection against the possible use of biological warfare by our enemies. Toward this end Army, Navy and civilian scientists, universities, private research institutions, industries and several Departments of the Government all worked together. The Chemical Warfare Service, now the Chemical Corps, was made responsible for the program in the War Department with the cooperation of the Office of the Surgeon General on certain medical aspects. The Navy Department worked in close collaboration with the War Department in this field and made important contributions to the program. Since these investigations involved many sciences and entirely new approaches, unique facilities had to be constructed to enable us properly to conduct our research.

Actually large-scale biological warfare has never been used by any nation. Our research indicated, however, that germs or their poisonous products could be used effectively as weapons of war. It was also realized from the results of this wartime research that work in this field could not be neglected in time of peace and had to be continued on a sufficient scale to provide us with adequate defenses and to enable us to utilize this weapon in the future should it become necessary. As a by-product of the research on this subject during and following the war much information of great peacetime benefit to mankind in the medical, agricultural, and allied fields has been freely given to the public. Over 160 technical articles describing these investigations have been released through the medium of scientific journals.

Unfortunately, the public has been given an exaggerated impression as to the potency and state of development of biological warfare. For example, it has been stated that a single plane with a small bomb filled with biological agent would be capable of wiping out the population of an entire city with a single blow. Such a statement is not in accord with the facts as we know them today. As a further example, in a recent article it was stated that one ounce of a particular biological material would be sufficient to kill 200,000,000 people. The facts are that it is impossible to spread an ounce of any kind of material for the purposes of warfare in such a manner as to affect even a small percentage of such a tremendous number of people.

Many other exaggerated statements have appeared. One article stated that biological warfare makes it possible to kill the inhabitants of an *entire continent* very quickly. Another stated that it would be a *simple matter* to spread plague in the United States. Still another maintained that a means is available for spreading various diseases among *millions of people* by dropping a *few capsules* from *one airplane*. Such claims are fantastic and have no basis in fact.

While it would be folly to underestimate the potentialities of biological warfare, there is no factual basis for *extravagant* claims of the existence of a biological super-weapon.

Many articles have described biological warfare as more terrible than the atomic bomb. The fact is that these two weapons differ from one another as basically that a direct comparison is meaningless. The atomic bomb destroys not only life but also buildings and other structures, and is in that respect similar to high explosives. In addition, atomic radiation may persist indefinitely in contaminated areas and produce serious effects on living matter. Biological warfare agents, on the other hand, affect only living matter, do not destroy material structures and, in most cases, are nonpersistent. Death, protracted sickness or only temporary incapacitation might be produced by man by the selection and dissemination of the proper biological agent.

Biological warfare is an attempt to harness certain forces of nature for purposes of war. In such warfare either epidemic or non-epidemic diseases might be used. In the language of biological warfare, an epidemic disease is one that is easily and rapidly spread from person to person, animal to animal, or plant to plant. A non-epidemic disease spreads less easily and therefore would be largely restricted to persons, animals or plants directly exposed to the germs as they were distributed during an attack. In the case of epidemic diseases of man the factors governing spread are not completely understood, and in any case not all are controllable; hence, it is not at all certain that an epidemic of significant proportions could be produced at will. Even if an epidemic were started, adequate public health and sanitation measures and proper treatment methods promptly instituted would tend to limit the spread and minimize the effects. The distribution of non-epidemic disease-producing agents and toxins would have to be very widespread to have a decisive effect. Biological warfare would not be instantly destructive of life and it should be appreciated that illness induced by biological agents may be counteracted by specific medical measures. An important defense against biological warfare lies in the early identification of diseases implanted and prompt institution of appropriate countermeasures to prevent further spread and restore the health of those affected. But it is obvious that extensive preparation for such defensive measures must be made in advance of an attack.

During times of peace various governmental agencies are concerned with the control of natural outbreaks of disease. Not only our population but also our crops and animals must be protected. To this end the U. S. Public Health Service, the Department of Agriculture, other Federal and many State and Municipal agencies are always on the alert. The threat of biological warfare has increased their responsibilities and difficulties. If a biological attack were made, the above agencies, in addition to the Armed Forces, would play an important role

(Continued on page 39)

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* * *

As a Chemical Corps reserve officer contemplating return to extended active duty will I, if accepted, be given a three year contract assuring me of continuous duty for that period of time?

Under the present procedure an officer is ordered to extended active duty for three years upon his request and it is problematical that he will remain for this period of time. However, no contract is offered and there is no absolute guarantee a reservist will be continued on active duty for the three year period.

* * *

I am a Reserve Officer, age 59, with 40 years service including 8 active and am a full time Federal employee. May I accept nondisability retirement pay under Title III, Public Law 810, at age 60 and continue as a full time Federal employee?

You cannot receive retirement pay under the provisions of Public Law 810 and, at the same time, receive payment from the Government as a Government employee. However, when you give up your Federal employment you can receive Civil Servcie retirement in addition to Reserve retirement.

* * *

In 1946 when I was separated from the Army without physical disability, and although the examining doctor was notified that there was a record of a service-incurred disability, no action was taken. Since separation this disability has become more aggrevated. As a Reserve Officer is the opportunity available to be recalled for the purpose of examination, observation and board action?

Write the Chief of Staff, D/A, requesting that you be returned to a hospital for observation and determination of your right to go before a retiring board. Due to a ruling of the Comptroller General, you cannot be placed on active duty but would be required to go to a hospital at your own expense. The possibilities of returning to a hospital rest with the Chief of Staff.

* * *

Can a Reserve Officer who has completed 20 years active commissioned service secure a commission in the Honorary Reserve? Also, can he then qualify for retirement at age 60?

Yes, to both question.

* * *

Is the retirement pay received by members of the reserve components under the provision of Public Law 810, 80th Congress taxable?

Yes.

* * *

Is a Reserve Officer on retired status subject to recall to active duty?

An officer receiving retirement pay and who holds a Reserve commission may be ordered to active duty in case of national emergency.

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utilized in World War II. This has demonstrated its wastefulness so far as technologists are concerned. Would it not be more logical to utilize the same reasoning which we use in planning for the appropriate allocation of industrial facilities? In that event, we would measure and estimate present and future supply and compare it with present and future requirements. As technology increases in importance on the national scene, such an activity could be extremely important to the progress of the country as a whole during the years of peace.

Technological Cataloging

In either war or peace, we will also need a catalogue or a series of catalogues containing careful evaluations of our technological manpower resources. Perhaps the logical agents for this task are the technical societies in which most of these individuals hold membership. It would also be necessary to set up within the governmental structure, possibly within the National Science Foundation if it is established, a small office to synthesize all existing information concerning the supply and the demand for technologists both presently and for a measurable period into the future.

In event of a national emergency this office would then poses a large reservoir of information which could immediately be made available in connection with the allocation and assignment of these individuals in accordance with national needs. Instead of being assigned by lot (draft) or directly commissioned as a result of competition between the individual Armed Services, the technologists could be assigned to appropriate military or civilian activities in accordance with their professional and personal competence and the demonstrated requirements. This would require that they be removed from the normal selective service system and that every technologist in the United States would be required to serve in the national interest.

It would also require the Armed Services to give special attention to the assignment of these individuals in accordance with requirements which they had worked out by careful analysis of their technical functions.

The analysis of World War II utilization of scientists and engineers mentioned above indicates that the directly commissioned personnel were the ones most effectively used. The assignment procedures herein proposed are the nearest equivalent to direct commissioning which can be devised on a national scale. Furthermore, they would allow the necessary flexibility for re-assignment of technologists in event the facilities in which they are employed are rendered inoperative by enemy attack.

Thus, the record demonstrates our need for a broad and unified directive policy for the wartime use of technologists. In the words of Walter J. Murphy who wrote recently in the Chemical and Engineering News[1], "It will be a sad day for the United States if we are forced suddenly into another global conflict and are without such a broad directive and the means to implement its recommendations. The day hostilities break out will be too late to establish a policy and institute ways and means of effectively utilizing the scienctific skills of this country. If we temporize until that moment, we will fall back on the wasteful and inefficient program of World War II. Now is the time (while there is yet time) to be realistic and constructive. Tomorrow may be too late."

[1]Chemical and Engineering News, Vol. 27, No. 4, Jan. 24, 1949. Editorial, p. 213.

SCIENTISTS IN UNIFORM

(Continued from page 23)

out in a number of comments and opinions because in a military organization it is generally considered that rank is proportional to competence. Unfortunately, rank often had little to do with technical capabilities. Scientists report that technical programs often suffered because the professional scientists held rank considerably lower than the officers with administrative duties who often made the final decisions effecting the technical work.

Assignment of Reserve Officers. The failure of the Organized Reserve Corps to operate effectively in the proper placement of scientists and engineers who held Reserve commissions is evidenced by the large percentage of Reserve officers who failed to utilize their technical competence while in uniform.

Physical Qualifications for Technical Assignments. The matter of physical qualifications was also commented upon by numbers of respondents. They pointed out that if they were sufficiently well qualified physically to be drafted into combat units, they should certainly be physically qualified to utilize their technical competence in military positions very similar to those they had been filling adequately in civilian life.

Other comments. Other suggestions for utilization are concerned with the assignment of rank on the basis of technical competence, training, and experience, instead of on the basis of age and seniority; the use of scientists as scientific consultants; or the simple statement that, if in uniform, all scientists should be used in a technical capacity.

A RESERVE LOOKS AT THE ASSOCIATION

(Continued from page 16)

ing Ground. While it is true that they probably could not accomplish much in the way of completing a new project, it is quite possible that their civilian experience and training would place them in such a position that they could suggest to or advise the permanent technicians in an advantageous capacity. In this manner the Reserve could obtain the desired points, while the army installation would profit by his effort, advice, and suggestions. Reserve Officers with technical backgrounds *do want* such active duty tours. Any effort that the Armed Forces Chemical Association can make to achieve this end would be greatly appreciated by all concerned.

Department of the Army Circular 210, dated 14 July 1948, makes it possible for civilians with technical training and experience to receive direct Reserve commissions. The rank of such commisions is dependent on the number of years devoted to technical work. At the present time there is no statement or decision evident regarding the possibility of a present Reserve officer resigning his current commission, and waiting a month or two, applying for a higher ranking commission under the above-mentioned circular. In the event an officer can use the above technique to get "promoted" would he lose his past earned retirement credit? Also, many current company grade Reserve officers (whose technical background and training qualify them for a field grade rank under Circular 210) have expressed resentment concerning the direct civilian commissioning of an individual of less experience to a Reserve rank senior to theirs.

If the Armed Forces Chemical Association can publish articles and obtain decisions on policy related to the above topics, it is believed it will be doing a real service to the isolated member as well as to non-members. (Editor's Note — The Association would like to have comments from the membership on Captain Nicholson's thought-provoking article.)

BOOK REVIEWS

INTELLIGENCE IS FOR COMMANDERS. Lt. Col. B. Davidson and Lt. Col. Robert R. Glass. xi 189 pages. The Military Service Publishing Co., Harrisburg, Pa., 1948. $3.85.

After a foreword by Lt. Gen. Manton S. Eddy, Commandant of Command and General Staff College at Fort Leavenworth, Kansas, the book opens with the following significant quotation from the Report of the Joint Committee on the Investigation of the Pearl Harbor Attack, Congress of the United States: "The consideration overshadowing all others in the minds of the Hawaiian commanders was the belief and conviction that Pearl Harbor would not be attacked . . . It explains the reason for no effective steps being taken to meet the Japanese raiders on the morning of December 7th." Colonels Davidson and Glass, who are members of the staff and faculty at Fort Leavenworth, then present the whole subject of military intelligence in a most interesting and practical manner, with numerous historical examples from World War II and previous wars to illustrate the various phases of the subject. Part One of the book deals with the basic principles of intelligence, the collection of information, the processing of information, the use of intelligence, and the direction of the collection effort. Part Two is concerned with the tactical study of the terrain and weather, counter-intelligence, intelligence standing operating procedures, intelligence training, and the duties of the intelligence officer. Part three is made up of a number of forms or checklists, some of which are partly completed, which are referred to in various parts of the text. These will be found to be especially useful to an intelligence officer.

—L. Wilson Greene

ORGANIC SYNTHESES. An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Volume 28. H. R. Snyder, Editor. vi 121 pages. John Wiley & Sons, Inc., New York, 1948. $2.50.

Proven methods for the preparation of the following compounds are described: 2-Acetothienone, 2-acetylfluorene, 9-acetylphenanthrene, 2-allylcyclohexanone, *o*-aminobenzaldehyde, *p*-aminophenyl disulfide, benzoyl disulfide, 9-bromophenanthrene, 4-bromo-*o*-xylene, 3-carbethoxycoumarin, *p*-chloroacetylacetanilide, *m*-chlorophenylmethylcarbinol, *m*-chlorostyrene, 9-cyanophenanthrene, *trans*-1, 2-cyclohexanediol, 4, 7-dichloroquinoline, 2, 5-dihydroxyacetophenone, diisovalerylmethane, 3, 4-dimethylaniline, 2, 4-dimethylquinoline, 1, 4-dinitronaphthalene, diphenylacetonitrile, ethyl azodicarboxylate, ethyl ethoxymethylenemalonate, fluorenone-2-carboxylic acid, hexamethylene chlorohydrin, hydroquinone diacetate, 2-hydroxycinchoninic acid, *dl*-isopropylideneglycol, methyl 4-keto-7-methyloctanoate, 4-nitro-1-napthylamine, *p*-nitrophenyl sulfide, phenanthrene-9-aldehyde, 1-phenyl-3-amino-5-pyrazolone, a-phenylthiourea, 2, 4, 7-trinitroflourenone, and vinyl chloroacetate. The foregoing names are those commonly used to identify the compounds and, in addition, the indexing name used by *Chemical Abstracts* is given as a subtitle in the text to facilitate a complete literature survey, if such is desired. The value of these annual contributions to our knowledge of preparatory organic chemistry has been well established over the years since Volume 1 was issued in 1921. The present volume will be particularly useful since it contains a cumulative subject index of material presented in Volumes 20 through 28 of this series.

—L. Wilson Greene

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NEW PUBLICATIONS

Contributions by Chemical Corps Personnel

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Research in Canada for national defense. Hugh M. Barrett, (Defense Research Experimental Station, Suffield, Alta., Canada). *Engineering Journal* 31, 271-4 (1948).

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ARMY CHEMICAL CENTER

Assistant Scientific Director, Technical Command

Walter H. C. Rueggeberg, Assistant Scientific Director of the Technical Command, became associated with the Chemical Corps in July, 1942, as a Reserve officer. At the end of his active duty period in 1946, Dr. Rueggeberg joined the Technical Command in a civilian capacity. During his six and one-half years of service in the Technical Command, he has been actively engaged in research and development on chemical warfare agents and other chemical substances, and processes leading to their production.

Prior to his association with the Chemical Corps, Dr. Rueggeberg attended the Infantry School, Fort Benning, Ga., where he graduated from the Combat Officers' Training course in 1942.

From 1941 to 1942, he was associated with the Carbide and Carbon Chemicals Corp. in South Charleston, W. Va., where he was engaged in research and development on aliphatic organic chemicals and surface-active agents.

He received his Ph.D. degree in chemistry from the Johns Hopkins University on June 3, 1941, on his 26th birthday, after having received his elementary and secondary school education in the public schools of Baltimore. He has had considerable experience in the teaching of organic, inorganic, and physical chemistry at the Johns Hopkins University.

Dr. Rueggeberg is the author of numerous papers on various aspects of organic and physical chemistry. He participates in the affairs of the American Chemical Society by occupying positions on the Executive Committee of the Maryland Section of the Society and on the Committee on Nomenclature of Organic Compounds. He is a member of the Division of Organic Chemistry of the American Chemical Society and of the American Association for the Advancement of Science.

As a Major in the Chemical Corps Reserve, he is a member of the 2401st Reserve Research and Development Group.

Assistant Scientific Director, Medical Division

William H. Chambers, veteran of two world wars, and formerly Associate Professor Physiology, Cornell University Medical College, has been named Assistant Scientific Director, Medical Division, Army Chemical Center, according to announcement by Col. J. R. Wood.

As a Major, later Lieutenant Colonel, Sanitary Corps, Dr. Chambers saw more than 34 months' service overseas in the ETO. As a member of the ETO Ration Board he participated in the conduct of field trials of combat rations with troops on maneuvers. Subsequently, he was named Chief of Nutrition Branch and Executive Officer of Preventive Medicine Division of the Office of Surgeon, Headquarters, United

(Continued on page 39)

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MEDICINE FROM MUSTARD GAS

(Continued from page 29)

pens, normal tissue function is restored but unfortunately arthritis may recur and the patient may be compelled to seek another form of therapy. BAL, of course, is not of advantage in all instances, but its record to date certainly warrants affirmation by continued investigation into its potentialities, and it is safe to say that medicine fully recognizes these possibilities. Let it be hoped that BAL may never be employed in the role for which it was originally intended, for since it has earned civilian status, it has acquired a notable reputation in peacetime applications.

The Chemical Corps of the United States Armed Forces is playing a leading part in the development of its agents for clinical use. For example, through treatment sets prepared by Merck & Co., Inc., of Rahway, N. J., it supplies the National Research Council Committee on Growth with required nitrogen-mustards. Its research has led in various directions and a chemical is not shelved after its warfare value is established or disproved. In fact constructive principles have come to light even though all of their constituents might not necessarily have had any war relation.

Recent experimentation, for instance, has confirmed the usefulness of PAPP, or *p*-aminopropiophenone, which has been found to afford protection against cyanide poisoning. Should PAPP prove to be as efficient after thorough trial as early observation would appear to indicate, it would eliminate one of the major hazards of the chemical industry. Diisopropyl fluorophosphate, more commonly known as DFP, is being used with success in cases of glaucoma, an eye disease in which the eye hardens due to increased fluid pressure within the eyeball, possibly resulting in blindness in a short time.

The Medical Division of the Chemical Corps also records among its accomplishments the preparation of an anti-flash-burn ointment. While the details of this and many other materials and topics being worked on are as yet unreleased, the ointment is stated to have protected animals on board ships at Bikini which showed charred portions after Operation Crossroads.

For security reasons, the facts of medical and chemical research within the armed forces must remain largely unknown for the present. Nevertheless clinical progress so far, with such valuable therapeutic achievements as the nitrogen-mustards for certain forms of malignancies, BAL for metallic poisoning, and DFP for glaucoma, sustains a belief that benefits to mankind are bound to be derived from organized accumulation of scientific knowledge, regardless of the character of the motivating mission —be it along the lines of biological warfare, radiological defense, vitamins, antibiotics, sulfa drugs, or whatever. The profits due humanity from technical advance compel scientists to follow constructive pursuits in conjunction with their aim to keep pace with the improvement of warfare chemistry. The record of the application of the fruits of these pursuits to clinical medicine prophesies a continuation of effort to produce medical and scientific benefits to society by means of forward-looking research.

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MILITARY APPLICATION

(Continued from page 7)

conservative basis. Thus a plant operating at a rate of one million kilowatts will produce 2 pounds of fissionable material per day. It has been stated that our plants operate at about this rate. It has even been directly stated that our rate of production is six pounds per day of fissionable material. These data are about two years old but using them as a conservative basis and combining them with the estimate of 30 pounds as the critical size leads to the production rate of one per week. On this basis the present stock of bombs would be conservatively estimated at 100 to 200. Other lines of reasoning lead to the same figure, and a more accurate estimate is no doubt available to one really interested in obtaining it. Yet just this February 1949 it was clearly stated that the United States Senate is being asked to make decisions whose validity hinge on the number of these bombs available without being given the figure. Since the store is undoubtedly large there seems little point in attempting to conceal the actual number of bombs on hand. A numerical superiority of ten to one in any weapon is quite sufficient to insure superiority in that particular category and it is only when the balance is close that secrecy is of importance. Furthermore we have stated above that all this accent on secrecy with respect to atomic weapons leads to the erroneous belief that it is this particular weapon on which we stake our future. Actually more powerful, or at least equally powerful, weapons exist and discussions of national policy should accent the whole picture rather than just one facet of it.

The one secret which has been kept quite well is the method of producing atomic bombs, but it should be clearly noted that it is only the details of the method which are secret. The broad line of approach and the guarantee of success have been supplied. Any feeling that secrecy here guarantees a monopoly of this weapon is bound to be wrong. It is interesting to note that American scientists freely predicted that other nations might be able to solve the problems involved in the release of atomic energy in a matter of three to five years after learning of our success. At the end of 1948, just as the three years had run out, the French announced the successful operation of an atomic pile even though it was not to be used for bomb production. If the politically unstable French can accomplish this, is it not feasible that other countries can do the same thing and, perhaps, make even more progress?

Secrecy of the type we have used around the atomic energy project is a sword with a blade on each end. It is just as apt to injure mortally the wielder of the sword as those against whom it was formed.

BIOLOGICAL WARFARE

(Continued from page 32)

in counteracting the implantation and spread of disease. We must guard not only against natural outbreaks of disease and biological attack in time of war, but also against the use of biological sabotage methods before a declaration of war has been made. Our food supplies would be particularly vulnerable to attack by saboteurs with biological weapons. We must, therefore, rely on the maintenance of our high standards of public health and sanitation, and on our protective measures for animals and crops as our first line of defense against any biological warfare attack. Appropriate steps are being taken to insure the coordination of the activities of our protective agencies. In addition, an active research program on biological warfare including methods for the prevention and treatment of diseases which might be caused by such warfare is being conducted in the interests of national defense.

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ASSISTANT SCIENTIFIC DIRECTOR, MEDICAL DIVISION

(Continued from page 37)

Kingdom Base and later as Nutrition Officer in 12th Army Group Headquarters.

During World War I Second Lieutenant Chambers served as a laboratory officer in Evacuation Hospitals 8 and 30 with the Army of Occupation.

After graduation from University of Illinois in 1915, two years with Illinois Experiment Station, and one year as a Research Fellow with Missouri Botanical Garden, Dr. Chambers was conferred the Ph.D. degree by Washington University in St. Louis in 1920. During the ensuing four years he performed cancer research at Barnard Free Dkin and Cancer Hospital and served as Assistant in Experimental Surgery at Washington University School of Medicine. There followed a two-year tour as a National Research Council Fellow in Cornell University Medical College Department of Physiology preceding two years more as Instructor in Physiology at Yale University School of Medicine. At the conclusion of the Yale instructorship, Dr. Chambers returned to Cornell University Medical College as Assistant Professor of Physiology in charge of chemical and metabolic research laboratories. In 1939 he was named Associate Professor.

For a four-year period, during 1937-41, Dr. Chambers was Associate and Assistant Editor of the Journal of Nutrition, and from 1946 through 1948, Secretary-Treasurer of the Federation of American Societies for Experimental Biology and Managing Editor of *Federation Proceedings.*

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PROBLEMS OF CHEMICAL OFFICER

(Continued from page 19)

tivities of the Chief Chemical Officer pertained to the effectiveness of toxic and smoke munitions when used tactically under the tropical conditions existing in the theater, for which no reliable data was available in the theater or in the United States. With the aid of a highly qualified officer, Major Howard Skipper, closest liaison was maintained with an Australian Experiment station functioning under the guidance of the British, in a tropical jungle area of northern Australia. Through this liaison, arrangements were made for practical experiments in the attack of a jungle area containing Japanese type defensive works, using U. S. airplanes and mustard gas munitions. The effectiveness on humans and on various animals that occupied the area, or who entered the area soon after the bombing, was carefully measured. Data was obtained which gave invaluable clues to the extra effectiveness which might be expected of mustard gas when used under tropical conditions.

Certain representatives of the NDRC were provided to the Chief Chemical Officer, and the results of the experiments in the Australian area were correlated with the experiments with which they were familiar, which had been carried out in the United States and at the tropical experimental station for the Chemical Warfare Service at San Jose, Panama. This data was combined with British and Canadian data, providing certain guides for the tactical employment of chemicals to permit a more scientific application of the use of chemicals than had previously been known. In order that this new concept of the use of chemicals should be known to the chemical personnel of all combat units, the Chief Chemical Officer arranged for a conference of the chemical officers of all combat units of the U. S. Forces, including representatives of Australian, British and United States commands in all areas opposed to Japan, the Australian Army, Navy and Air Force, and the highest technical representatives of the Chief, Chemical Warfare Service. The report of the conference with its annexes, which was furnished to all concerned, provided the basis for an advanced scientific application of chemical warfare.

In order to make a tactical evaluation of chemical munitions under the specific conditions of contemplated use, the Chief Chemical Officer recommended the secured formation of a group of military and civilian scientists designated the Far East Technical Unit. This unit was equipped to carry out field tests with our chemical munitions, and had the necessary samplers and other equipment to make a reasonably accurate estimate of their effectiveness. For example, as the war closed, this unit had a test set up on the island of Corregidor, to determine whether Japanese field fortifications on mountain sides and ridge lines could be attacked effectively with chemical munitions from the air.

The magnitude of the accomplishments of the small group of chemical officers, initially almost entirely inexperienced in their duties, could have resulted only by a careful analysis of the capabilities of each one and then the development of those capabilities of the maximum.

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PLASTICS FOR THE CHEMICAL CORPS

(Continued from page 31)

The expanding interest of the Chemical Corps in plastics indicated above has resulted in the recent establishment of a modern, well-equipped, plastics laboratory at the Army Chemical Center. This laboratory is completely equipped for the synthesis of materials, but it is mainly intended for development work on items and components to be fabricated from commercially available resins and plasticizers. Facilities for grinding, compounding, injection and compression molding, and film forming are provided. Already this laboratory has fabricated or molded dozens of experimental models of frangible phenolic detonator retainers for smoke tank closures, cellulose nitrate igniters, polytetrafluoroethylene valve seats special-purpose gaskets, polymethyl methacrylate disc computers, cast allyl resin lenses, and plastic filter frames.

In the very near future it appears most probable that the enlarged scope of plastics in the field of engineering will result in further applications arousing no more general curiosity or interest than the application of any of the common metallurgical alloys.

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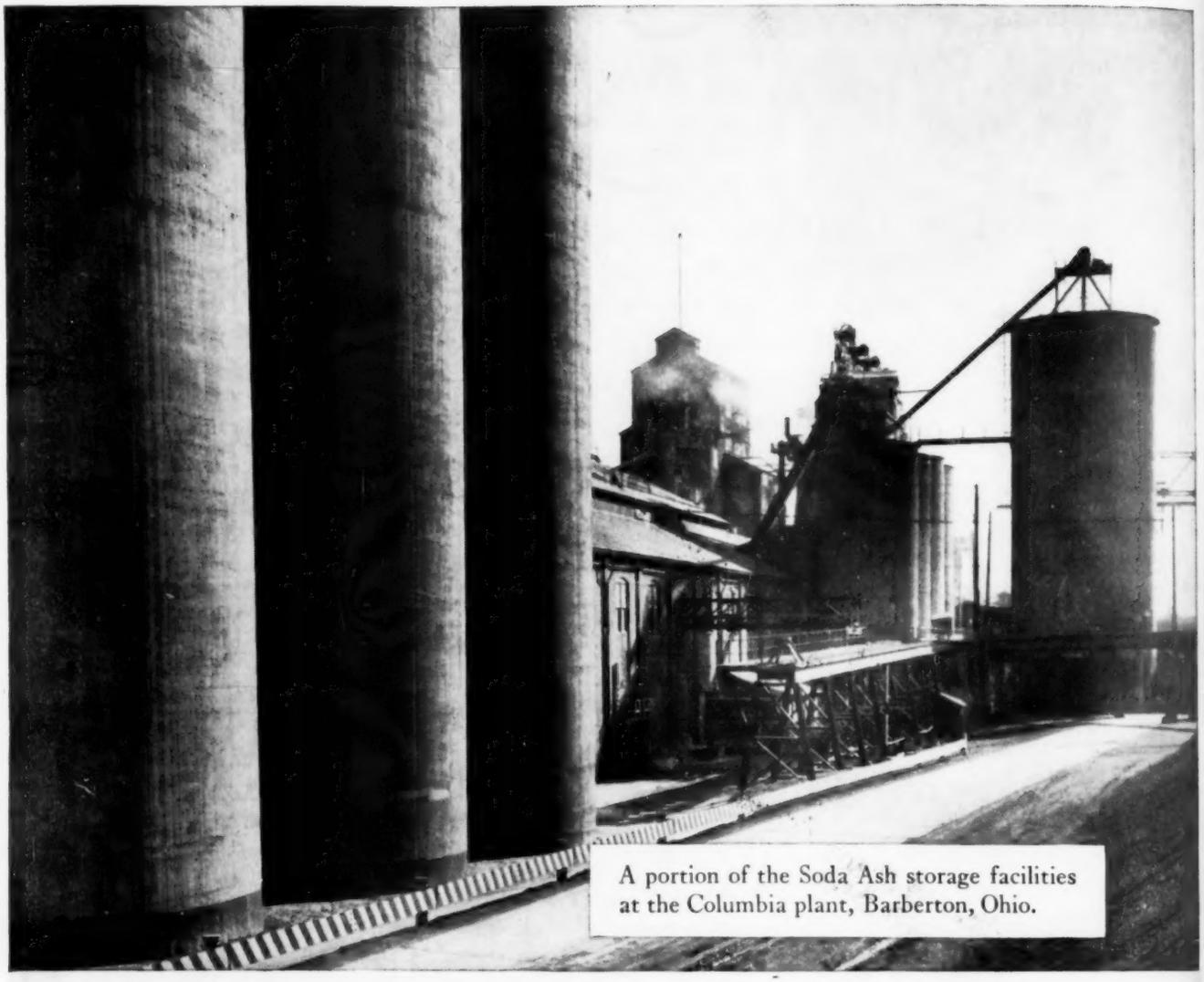
THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN



A portion of the Soda Ash storage facilities at the Columbia plant, Barberton, Ohio.

Here's why it pays you to use Columbia Soda Ash — Light or Dense

Made for Your Requirements—Columbia's original product; manufactured, since 1899, with intimate knowledge of the specific needs of all types of industrial applications.

Controlled Quality—Eliminates variables which can cause production difficulties. Highest standards maintained to produce Soda Ash which always tests 99-100% Na_2CO_3, with an Na_2O equivalent of 58% plus.

Precise Grading—Density, for the grade specified, is uniform in particle size. Your production methods require no adjustments for Columbia Soda Ash.

Check your Soda Ash requirements with Columbia . . . you'll receive excellent service—another important factor in your operations.

COLUMBIA CHEMICALS

CHICAGO · BOSTON · NEW YORK · CINCINNATI · MINNEAPOLIS · ST. LOUIS · PITTSBURGH · CLEVELAND · PHILADELPHIA · CHARLOTTE · SAN FRANCISCO

PAINT · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY